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(54) Title: POLYCYSTIC KIDNEY DISEASE 1 GENE AND USES THEREOF (57) Abstract Autosomal dominant polycystic kidney disease (ADPKD) is a common genetic disorder which frequently results in renal failure, due to progressive cyst development. The major locus, PKD1, maps to 16p13.3. A chromosome translocation is identified associated with ADPKD which disrupts a gene (PBP), encoding a 14 kb transcript, in the PKD1 candidate region. Further mutations of the PBP gene were found in PKD1 patients confirming that PBP is the PKD1 gene. This gene is located adjacent to the tuberous sclerosis (2) locus in a genomic region that is reiterated more proximally on 16p. The duplicate area encodes three transcripts substantially homologous to the PKD1 transcript. Partial sequence analysis of the PKD1 transcript shows that it encodes a novel protein. Screening of actual or suspected ADPKD patients for normal or mutated PKD1 can be used for diagnostic purposes. PKD1-associated disorders such as ADPKD may be treated or prevented by PKD1 gene therapy and/or administration of functional PKD1 protein to affected cells.		

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POLYCYSTIC KIDNEY DISEASE 1 GENE AND USES THEREOF

The present invention relates to the polycystic kidney disease 1 (PKD1) gene, mutations thereof in patients having PKD1-associated disorders, the protein encoded by the PKD1 gene, and their uses in diagnosis and therapy.

Background to the Invention

All references mentioned herebelow are listed in full at the end of the description which are herein incorporated by reference in their entirety. Except where the context clearly indicates otherwise, references to the PBP gene, transcript, sequence, protein or the like can be read as referring to the PKD1 gene, transcript, sequence, protein or the like, respectively.

A landmark study by Dalgaard, 1957 showed that autosomal dominant polycystic kidney disease (ADPKD) also termed adult polycystic kidney disease (APKD) is one of the commonest genetic diseases of man (approximately 1/1000 individuals affected). The major feature of this dominant disease is the development of cystic kidneys which commonly leads to renal failure in adult life. This simple description, however, belies the diverse systemic disorder, affecting many other organs (reviewed in Gabow, 1990) and one which occasionally presents in childhood (Fink, et al., 1993; Zerres, et al., 1993). Extrarenal manifestations include liver cysts (Milutinovic, et al., 1980), and more rarely cysts of the pancreas (Gabow, 1993) and other organs. Intracranial aneurysms occur in approximately 5% of patients and are a significant cause of morbidity and mortality due to subarachnoid haemorrhage (Chapman, et al., 1992). More recently, an increased prevalence of cardiac valve defects (Hossack, et al., 1988), herniae (Gabow, 1990) and colonic

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diverticulae (Scheff, et al., 1980) has been reported.

The major cause of morbidity in ADPKD, however, is progressive renal disease characterised by the formation and enlargement of fluid filled cysts, resulting in grossly enlarged kidneys. Renal function deteriorates as normal tissue is compromised by cystic growth, resulting in end stage renal disease (ESRD) in more than 50% of patients by the age of 60 years (Gabow, et al., 1992): ADPKD accounts for 8-10% of all renal transplantation and dialysis patients in Europe and the USA (Gabow, 1993). Biochemical studies have suggested several potential causes of cyst formation and development, including: abnormal epithelial cell growth, alterations to the extracellular matrix and changes in cellular polarity and secretion (reviewed in Gabow, 1991; Wilson and Sherwood, 1991). The primary defect in ADPKD, however, remains unclear and considerable effort has therefore been applied to identifying the defective gene(s) in this disorder by genetic approaches.

The first step towards positional cloning of an ADPKD gene was the demonstration of linkage of one locus now designated the polycystic kidney disease 1 (PKD1) locus to the a globin cluster on the short arm of chromosome 16 (Reeders, et al., 1985). Subsequently, families with ADPKD unlinked to markers of 16p were described (Kimberling, et al., 1988; Romeo, et al., 1988) and a second ADPKD locus (PKD2) has recently been assigned to chromosome region 4q13-q23 (Kimberling, et al., 1993; Peters, et al., 1993). It is estimated that approximately 85% of ADPKD is due to PKD1 (Peters and Sandkuijl, 1992) with PKD2 accounting for most of the remainder. PKD2 appears to be a milder condition with a later age of onset and ESRD (Parfrey, et al., 1990; Gabow, et al., 1992; Ravine, et al., 1992).

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The position of the PKD1 locus was refined to chromosome band 16p13.3 and many markers were isolated from that region (Breuning, et al., 1987; Reeders, et al., 1988; Breuning, et al., 1990; Germino, et al., 1990; Hyland, et al., 1990; Himmelbauer, et al., 1991). Their order, and the position of the PKD1 locus, has been determined by extensive linkage analysis in normal and PKD1 families and by the use of a panel of somatic cell hybrids (Reeders, et al., 1988; Breuning, et al., 1990; Germino, et al., 1990). An accurate long range restriction map (Harris, et al., 1990; Germino, et al., 1992) has located the PKD1 locus in an interval of approximately 600 kb between the markers GGG1 and SM7 (Harris, et al., 1991; Somlo, et al., 1992) (see Figure 1a). The density of CpG islands and identification of many mRNA transcripts indicated that this area is rich in gene sequences. Germino et al (1992) estimated that the candidate region contains approximately 20 genes.

Identification of the PKD1 gene from within this area has thus proved difficult and other means to pinpoint the disease gene were sought. Linkage disequilibrium has been demonstrated between PKD1 and the proximal marker VK5, in a Scottish population (Pound, et al., 1992) and between PKD1 and BLu24 (see Figure 1a), in a Spanish population (Peral, et al., 1994). Studies with additional markers have shown evidence of a common ancestor in a proportion of each population (Peral, et al., 1994; Snarey, et al., 1994), but the association has not precisely positioned the PKD1 locus.

Disease associated genomic rearrangements, detected by cytogenetics or pulsed field gel electrophoresis (PFGE) have been instrumental in the identification of various genes associated with various genetic disorders. Hitherto, no such abnormalities

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related to PKD1 have been described. This situation contrasts with that for the tuberous sclerosis locus, which lies within 16p13.3 (TSC2). In that case, TSC associated deletions were detected by PFGE within the interval thought to contain the PKD1 gene and their characterisation was a significant step toward the rapid identification of the TSC2 gene (European Chromosome 16 Tuberous Sclerosis Consortium, 1993). The TSC2 gene therefore maps within the candidate region for the hitherto unidentified PKD1 gene; as polycystic kidneys are a feature common to TSC and ADPKD (Bernstein and Robbins, 1991) the possibility of an aetiological link, as proposed by Kandt et al. (1992), was considered.

We have now identified a pedigree in which the two distinct phenotypes, typical ADPKD or TSC, are seen in different members. In this family, the two individuals with ADPKD are carriers of a balanced chromosome translocation with a breakpoint within 16p13.3. We have located the chromosome 16 translocation breakpoint and a gene disrupted by this rearrangement has been defined; the discovery of additional mutations of that gene in other PKD1 patients shows that we have identified the PKD1 gene.

Summary of the Invention

Accordingly, in one aspect, this invention provides an isolated, purified or recombinant nucleic acid sequence comprising:-

- (a) a PKD1 gene or its complementary strand,
- (b) a sequence substantially homologous to, or capable of hybridising to, a substantial portion of a molecule defined in (a) above,
- (c) a fragment of a molecule defined in (a) or (b) above. In particular, there is provided a sequence wherein the PKD1 gene has the partial nucleic acid sequence according to Figure 7 and/or 10. The

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invention therefore includes a DNA molecule selected from:

- (a) a PKD1 gene or its complementary strand,
- (b) a sequence substantially homologous to, or
5 capable of hybridising to, a substantial portion of a molecule defined in (a) above,
- (c) a molecule coding for a polypeptide having the partial sequence of Figure 7,
- (d) genomic DNA corresponding to a molecule in
10 (a) above; and
- (e) a fragment of a molecule defined in any of (a), (b), (c) or (d) above.

The PKD1 gene described herein is a gene found on human chromosome 16, and the results of familial
15 studies described herein form the basis for concluding that this PKD1 gene encodes a protein called PKD1 protein which has a role in the prevention or suppression of ADPKD. The PKD1 gene therefore includes the DNA sequences shown in Figures 7 and 10, and all
20 functional equivalents. The gene furthermore includes regulatory regions which control the expression of the PKD1 coding sequence, including promotor, enhancer and terminator regions. Other DNA sequences such as introns spliced from the end-product PKD1 RNA
25 transcript are also encompassed. Although work has been carried out in relation to the human gene, the corresponding genetic and functional sequences present in lower animals are also encompassed.

The present invention therefore further provides a
30 PKD1 gene or its complementary strand having the partial sequence according to Figure 7. In particular, it provides a PKD1 gene or its complementary strand having the partial sequence of Figures 7 and/or 10 which gene or strand is mutated in some ADPKD patients
35 (more specifically, PKD1 patients).

The invention further provides a nucleic acid sequence comprising a mutant PKD1 gene, especially one selected from a sequence comprising a partial sequence according to Figures 7 and/or 10 when:

- (a) [OX114] base pairs 1746-2192 as defined in Figure 7 are deleted
5 (446bp);
- (b) [OX32] base pairs 3696-3831 as defined in Figure 7 are deleted by a splicing defect;
- (c) [OX875] about 5.5kb flanked by the two XbaI sites shown in Figure 3a are deleted and the EcoRI site separating the CW10 (41kb) and JH1
10 (18kb) sites is thereby absent
- (d) [WS53] about 100kb extending between the JH1 and CW21 and the SM6 and JH17 sites shown in Figure 6 and the PKD1 gene is thereby absent, the deletion lying proximally between SM6 and JH13;
- (e) [461] 18bp are deleted in the 75bp intron amplified by the
15 primer pair 3A3C insert at position 3696 of the 3' sequence as shown in Figure 11;
- (f) [OX1054] 20bp are deleted in the 75bp intron amplified by the primer pair 3A3C insert at position 3696 of the 3' sequence as shown in Figure 11;
- 20 (g) [WS212] about 75kb are deleted between SM9-CW9 distally and the PKD1 3'UTR proximally as shown in Figure 12;
- (h) [WS-215] about 160kb are deleted between CW20 and SM6-JH17 as shown in Figure 12;
- (i) [WS-227] about 50kb are deleted between CW20 and JH11 as shown in
25 Figure 12;
- (j) [WS-219] about 27kb are deleted between JH1 and JH6 as shown in Figure 12;
- (k) [WS-250] about 160kb are deleted between CW20 and BLu24 as shown in Figure 12;
- 30 (l) [WS-194] about 65kb is deleted between CW20 and CW10.

The invention therefore extends to RNA molecules comprising an RNA sequence corresponding to any of the DNA sequences set out above. The molecule is preferably the transcript reference PBP and

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identifiable from the restriction map of Figure 3a and having a sequence of about 14 Kb.

In another aspect, the invention provides a nucleic acid probe having a sequence as set out above; in particular, this invention extends to a purified nucleic acid probe which hybridises to at least a portion of the DNA or RNA molecule of any of the preceding sequences. Preferably, the probe includes a label such as a radiolabel for example a ^{32}P label.

In another aspect, this invention provides a purified DNA or RNA coding for a protein comprising the amino acid sequence of Figure 7 and/or 10, or a protein polypeptide having homologous properties with said protein, or having at least one functional domain or active site in common with said protein.

The DNA molecule defined above may be incorporated in a recombinant cloning vector for expressing a protein having the amino acid sequence of Figure 7 and/or 10, or a protein or a polypeptide having at least one functional domain or active site in common with said protein.

In another aspect, the invention provides a polypeptide encoded by a sequence as set out above, or having the amino acid sequence according to the partial amino acid sequence of Figure 7 and/or 10, or a protein or polypeptide having homologous properties with said protein, or having at least one functional domain or active site in common with said protein. In particular, there is provided an isolated, purified or recombinant polypeptide comprising a PKD1 protein or a mutant or variant thereof or encoded by a sequence set out above or a variant thereof having substantially the same activity as the PKD1 protein.

This invention also provides an in vitro method of determining whether an individual is likely to be

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affected with tuberous sclerosis, comprising the steps of:

5 assaying a sample from the individual to determine the presence and/or amount of PKD1 protein or polypeptide having the amino acid sequence of Figure 7 and/or 10.

10 Additionally or alternatively, a sample may be assayed to determine the presence and/or amount of mRNA coding for the protein or polypeptide having the amino acid sequence of Figure 7 and/or 10, or to determine the fragment lengths of fragments of nucleotide sequences coding for the protein or polypeptide of Figure 7 and/or 10, or to detect inactivating mutations in DNA coding for a protein having the amino acid
15 sequence of Figure 7 and/or 10 or a protein having homologous properties. Said screening preferably includes applying a nucleic acid amplification process to said sample to amplify a fragment of the DNA sequence. Said nucleic acid amplification process
20 advantageously utilizes at least one of the following sets of primers as identified herein:-

 AH3 F9 : AH3 B7
 3A3 C1 : 3A3 C2
25 AH4 F2 : JH14 B3

 Alternatively, said screening method may comprise digesting said sample to provide EcoRI fragments and hybridising with a DNA probe which hybridises to the
30 EcoRI fragment identified (A) in Figure 3(a), and said DNA probe may comprise the DNA probe CW10 identified herein.

 Another screening method may comprise digesting said sample to provide BamHI fragments and hybridising
35 with a DNA probe which hybridises to the BamHI fragment

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identified (B) in Figure 3 (a), and said DNA probe may comprise the DNA probe 1A1H.6 identified herein.

5 A method according to the present invention may comprise detecting a PKD1-associated disorder in a patient suspected of having or having predisposition to, said disorder, the method comprising detecting the presence of and/or evaluating the characteristics of PKD1 DNA, PKD1 mRNA and/or PKD1 protein in a sample taken from the patient. Such method may comprise
10 detecting and/or evaluating whether the PKD1 DNA is deleted, missing, mutated, aberrant or not expressing normal PKD1 protein. One way of carrying out such a method comprises:

- 15 A. taking a biological, tissue or biopsy sample from the patient;
- B. detecting the presence of and/or evaluating the characteristics of PKD1 DNA, PKD1 mRNA and/or PKD1 protein in the sample to obtain a first set of results;
- 20 C. comparing the first set of results with a second set of results obtained using the same or similar methodology for an individual not suspected of having said disorders; and if the first and second sets of results differ in that the PKD1 DNA is deleted, missing, aberrant, mutated or not expressing PKD1
25 protein then that indicates the presence, predisposition or tendency of the patient to develop said disorders.

A specific method according to the invention comprises extracting a sample of PKD1 DNA or DNA from
30 the PKD1 locus purporting to be PKD1 DNA from a patient, cultivating the sample in vitro and analysing the resulting protein, and comparing the resulting protein with normal PKD1 protein according to the well-established Protein Truncation Test.

35 Less sensitive tests include analysis of RNA using RT PCR (reverse transcriptase polymerase chain

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reaction) and examination of genomic DNA.

On the other hand, if step C of the method is replaced by:

5 C. comparing the first set of results with a second set of results obtained using the same or similar methodology in an individual known to have the or at least one of said disorder(s); and if the first and second sets of results are substantially identical, this indicates that the PKD1 DNA in the patient is
10 deleted, mutated or not expressing normal PKD1 protein.

The invention further provides a method of characterising a mutation in a subject suspected of having a mutation in the PKD1 gene, which method comprises:

15 A. amplifying each of the exons in the PKD1 gene of the subject;

B. denaturing the complementary strands of the amplified exons;

20 C. diluting the denatured separate, complementary strands to allow each single-stranded DNA molecule to assume a secondary structural conformation;

D. subjecting the DNA molecule to electrophoresis under non-denaturing conditions;

25 E. comparing the electrophoresis pattern of the single-stranded molecule with the electrophoresis pattern of a single-stranded molecule containing the same amplified exon from a control individual which has either a normal or PKD1 heterozygous genotype; and

30 F. sequencing any amplification product which has an electrophoretic pattern different from the pattern obtained from the DNA of the control individual.

The invention also extends to a diagnostic kit for carrying out a method as set out above, comprising
35 nucleic acid primers for amplifying a fragment of the DNA or RNA sequences defined above. The nucleic acid

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primers may comprise at least one of the following sets:

5 AH3 F9 : AH3 B7
 3A3 C1 : 3A3 C2
 AH4 F2 : JH14 B3

10 Another embodiment of kit may combine one or more substances for digesting a sample to provide EcoRI fragments and a DNA probe as previously defined.

 A further embodiment of kit may comprise one or more substances for digesting a sample to provide BamHI fragments and a DNA probe as previously defined.

15 Still further, a kit may include a nucleic acid probe capable of hybridising to the DNA or RNA molecule previously defined.

20 A vector (such as Bluescript (available from Stratagene)) comprising a nucleic acid sequence set out above; and a host cell (such as E. coli strain SL-1 Blue (available from Stratagene)) transfected or transformed with the vector are also provided, together with the use of such a vector or a nucleic acid sequence set out above in gene therapy and/or in the preparation of an agent for treating or preventing a
25 PKD1-associated disorder. Therefore there is further provided a method of treating or preventing a PKD1-associated disorder which method comprises administering to a patient in need thereof a functional PKD1 gene to affected cells in a manner that permits
30 expression of PKD1 protein therein and/or a transcript produced from a mutated chromosome (such as the deleted WS-212 chromosome) which is capable of expressing functional PKD1 protein therein.

35 The invention also extends to any inventive combination of features set out above or in the following description.

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Brief Description Of The Drawings

Figure 1a (top): A long range map of the terminal region of the short arm of chromosome 16 showing the PKD1 candidate region defined by genetic linkage analysis. The positions of selected DNA probes and microsatellites used for haplotype, linkage or heterozygosity analyses are indicated. Markers previously described in linkage disequilibrium studies are shown in bold (from: Harris, et al., 1990; Harris, et al., 1991; Germino, et al., 1992; Somlo, et al., 1992; Peral, et al., 1994; Snarey, et al., 1994).

(bottom): A detailed map of the distal part of the PKD1 candidate region showing: the area of 16p13.3 duplicated in 16p13.1 (hatched); C, Cla I restriction sites; the breakpoints in the somatic cell hybrids, N-OH1 and P-MWH2A; DNA probes and the TSC2 gene. The limits of the position of the translocation breakpoint found in family 77 (see b), determined by evidence of heterozygosity (in 77-4) and PFGE (see c and text) is also indicated. The contig covering the 77 breakpoint region consists of the cosmids: 1, CW9D; 2, ZDS5; 3, JH2A; 4, REP59; 5, JC10.2B; 6, CW10III; 7, SM25A; 8, SMII; 9, NM17.

Figure 1b: Pedigree of family 77 which segregates a 16;22 translocation; showing the chromosomal composition of each subject. Individuals 77-2 and 77-3 have the balanced products of the exchange - and have PKD1; 77-4 is monosomic for 16p13.3-->16pter and 22q11.21-->22pter - and has TSC.

Figure 1c: PFGE of DNA from members of the 77 family: 77-1 (1); 77-2 (2); 77-3 (3); 77-4 (4); digested with Cla I and hybridised with SM6. In addition to the normal fragments of 340 and partially digested fragment of 480 kb a proximal breakpoint fragment of approximately 100 kb (arrowed) is seen in individuals, 77-2, 77-3 and 77-4; concordant with

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segregation of the der(16) chromosome.

Figure 2: FISH of the cosmid CW10III (cosmid 6; Figure 1a) to a normal male metaphase. Duplication of this locus is illustrated with two sites of hybridisation on 16p; the distal site (the PKD1 region) is arrowed. The signal from the proximal site (16p13.1) is stronger than that from the distal, indicating that sequences homologous to CW10III are reiterated in 16p13.1.

Figure 3a: A detailed map of the 77 translocation region showing the precise localisation of the 77 breakpoint and the region that is duplicated in 16p13.1 (hatched). DNA probes (open boxes); the transcripts, PKD1 and TSC2 (filled boxes; with direction of transcription indicated by an arrow) and cDNAs (grey boxes) are shown below the genomic map. The known genomic extent of each gene is indicated at the bottom of the diagram and the approximate genomic locations of each cDNA is indicated under the genomic map. The positions of genomic deletions found in PKD1 patients, OX875 and OX114, are also indicated. Restriction sites for EcoR I (E) and incomplete maps for BamH I (B); Sac I (S) and Xba I (X) are shown. SM3 is a 2kb BamH1 fragment shown at the 5' end of the gene.

Figure 3b: Southern blots of BamH I digested DNA from individuals: 77-1 (1); 77-2 (2); and 77-4 (4) hybridised with: left panel, 8S3 and right panel, 8S1 (see a). 8S3 detects a novel fragment on the telomeric side of the breakpoint (12 kb: arrowed) associated with the der(22) chromosome in 77-2, but not 77-4; 8S1 identifies a novel fragment on the centromeric side of the breakpoint (9 kb: arrowed) - associated with the der(16) chromosome - in 77-2 and 77-4. The telomeric breakpoint fragment is also seen weakly with 8S1 (arrowed) indicating that the breakpoint lies in the distal part of 8S1. The 8S3 and 8S1 loci are both

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5 duplicated; the normal BamH I fragment detected at the 16p13.3 site by these probes is 11 kb (see a), but a similar sized fragment is also detected at the 16p13.1 site. Consequently, the breakpoint fragments are much fainter than the normal (16p13.1 plus 16p13.3) band.

10 **Figure 4a:** PBP cDNA, 3A3, hybridised to a Northern blot containing ~1 mg polyA selected mRNA per lane of the tissue specific cell lines: lane 1, MJ, EBV-transformed lymphocytes; lane 2, K562, erythroleukaemia; lane 3, FS1, normal fibroblasts; lane 4, HeLa, cervical carcinoma; lane 5, G401, renal Wilm's tumour; lane 6, Hep3B, hepatoma; lane 7, HT29, colonic adenocarcinoma; lane 8, SW13, adrenal carcinoma; lane 9, G-CCM, astrocytoma. A single transcript of approximately 14 kb is seen; the highest level of expression is in fibroblasts and in the astrocytoma cell line, G-CCM. Although in this comparative experiment little expression is seen in lanes 1, 4 and 7, we have demonstrated at least a low level of expression in these cell lines on other Northern blots and by RT-PCR (see later).

20 **Figure 4b:** A Northern blot containing ~ 20 mg of total RNA from the cell line G-CCM hybridised with cDNAs or a genomic probe which identify various parts of the PBP gene. Left panel, a single ~14 kb transcript is seen with a cDNA from the single copy area, 3A3. Right panel, a cDNA, 21P.9, that is homologous to parts of the region that is duplicated (JH12, JH8 and JH10; see Figure 3a) hybridises to the PBP transcript and three novel transcripts; HG-A (~ 21 kb), HG-B (~ 17 kb) and HG-C (8.5 kb). A similar pattern of transcripts is seen with cDNAs and genomic fragments that hybridise to the area between JH5 and JH13, with the exception of the JH8 area. Middle panel, JH8 hybridises to the transcripts PBP, HG-A and HG-B but not to HG-C.

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Figure 4c: A Northern blot of 20mg total fibroblast RNA from: normal control (N); 77-2 (2); 77-4 (4) hybridised with 8S1, which contains the 16;22 translocation breakpoint (see Figure 3). A transcript of ~ 9 kb (PBP-77) is identified in the two patients with this translocation but not in the normal control. PBP-77 is a chimeric PBP transcript formed due to the translocation and is not seen in 77-2 or 77-4 RNA with probes which map distal to the breakpoint.

Figure 5a: FIGE of DNA from: normal (N) and ADPKD patient OX875 (875), digested with EcoR I and hybridised with, left panel, CW10; middle panel, JH1. Normal fragments of 41 kb (plus a 31 kb fragment from the 16p13.1 site), CW10, and 18 kb, JH1, are identified with these probes; OX875 has an additional 53 kb band (arrowed). The EcoR I site separating these two fragments is removed by the deletion (see Figure 3a). The right panel shows a Southern blot of BamH I digested DNA (as above) hybridised with 1A1H.6. A novel fragment of 9.5 kb is seen in OX875 DNA, as well as the normal 15 kb fragment. These results indicate that OX875 has a 5.5 kb deletion; its position was determined more precisely by mapping relative to two Xba I sites which flank the deletion (see figure 3a).

Figure 5b: Northern blot of total fibroblast RNA, as (a), hybridised with the cDNAs, AH4, 3A3 and AH3. A novel transcript (PBP-875) of ~ 11 kb is seen with AH4 (the band is reduced in intensity because the probe is partly deleted) and AH3 (arrowed), which flank the deletion, but not 3A3 which is entirely deleted (see figure 3a). The transcripts HG-A, HG-B and HG-C, from the duplicated area, are seen with AH3 (see figure 4b).

Figure 5c: Left panel; FIGE of DNA from: normal (N) and ADPKD patient OX114 (114), digested with EcoR I and hybridised with CW10; a novel fragment of 39 kb (arrowed) is seen in OX114. Middle panel; DNA, as

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above, plus the normal mother (M) and brother (B) of OX114 digested with BamH I and hybridised with CW21. A larger than normal fragment of 19 kb (arrowed) was detected in OX114 but not other family members due to deletion of a BamH I site; together these results are consistent with a 2 kb deletion (see Figure 3a). Right panel; RT-PCR of RNA, as above, with primers flanking the OX114 deletion (see Experimental Procedures). A novel fragment of 810 bp (arrowed) is seen in OX114, indicating a deletion of 446 bp in the PBP transcript.

Figure 5d: RT-PCR of RNA from: ADPKD patient OX32 (32) plus the probands, normal mother (M) and affected father (F) and sibs (1) and (2) using the C primer pair from 3A3 (see Experimental Procedures). A novel fragment of 125 bp is detected in each of the affected individuals.

Figure 6: Map of the region containing the TSC2 and PBP genes showing the area deleted in patient WS-53 and the position of the 77 translocation breakpoint. Localisation of the distal end of the WS-53 deletion was previously described (European Chromosome 16 Tuberous Sclerosis Consortium, 1993) and we have now localised the proximal end between SM6 and JHI7. The size of the aberrant Mlu I fragment in WS-53, detected by JH1 and JH17, is 90kb and these probes lie on adjacent Mlu I fragments of 120kb and 70kb, respectively. Therefore the WS-53 deletion is ~ 100kb. Restriction sites for: Mlu I (M); Nru I (R); Not I (N); and partial maps for Sac II (S) and BssH II (H) are shown. DNA probes (open boxes) and the TSC2 and PBP transcripts (filled boxes) are indicated below the line with their known genomic extents (brackets). The locations of the microsatellites KG8 and SM6 are also indicated.

Figure 7: The partial nucleotide sequence (cDNA) of the PKD1 transcript extending 5631bp to the 3' end

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of the gene. The corresponding predicted protein (also shown in SEQ ID NO: 4:) is shown below the sequence and extends from the start of the nucleotide sequence. The GT-repeat, KG8, is in the 3' untranslated region
5 between 5430-5448 bp. This sequence corresponds to GenBank Accession No. L33243 and is shown in SEQ ID NO: 3:.

Figure 8: The sequence of the probe 1A1H0.6 (also shown in SEQ ID NO: 5:).

10 **Figure 9:** The sequence (SEQ ID NO: 6:) of the probe CW10 which is about 0.5kb.

Figure 10: The larger partial nucleotide sequence (SEQ ID NO: 1:) of the PKD1 transcript (cDNA) extending from bp 2 to 13807bp to the 3' end of the gene together
15 with the corresponding predicted protein (also shown in SEQ ID NO: 2:). This larger partial sequence encompasses the (smaller) partial sequence of Figure 7 from amino acid no. 2726 in SEQ ID NO: 3: and relates to the entire PKD1 gene sequence apart from its extreme
20 5' end.

Figure 11: A map of the 75bp intron amplified by the primer set 3A3C insert at position 3696 of the 3' sequence showing the positions of genomic deletions found in PKD1 patients 461 and OX1054.

25 **Figure 12:** A map of the region of chromosome 16 containing the TSC2 and PKD1 genes showing the areas affected in patients WS-215, WS-250, WS-212, WS-194, WS-227 and WS-219; also WS-53 (but cf. Figure 6). Genomic sites for the enzymes MluI (M), ClaI (C), PvuI (P) and NruI (R) are shown. Positions of single copy probes and cosmids used to screen for deletions are shown below the line which represents ~400kb of genomic
30 DNA. The genomic distribution of the approximately 45kb TSC2 gene and known extent of the PKD1 gene are indicated above. The hatched area represents an ~50kb
35

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region which is duplicated more proximally on chromosome 16p.

Detailed Description of the Drawings

A translocation associated with ADPKD

5 A major pointer to the identity of the PKD1 gene was provided by a Portuguese pedigree (family 77) with both ADPKD and TSC (Figure 1b). Cytogenetic analysis showed that the mother, 77-2, has a balanced translocation, 46XX t(16;22)(p13.3;q11.21) which was
10 inherited by her daughter, 77-3. The son, 77-4, has the unbalanced karyotype, 45XY-16-22+der(16)(16qter-->16p13.3::22q11.21-->2qter) and consequently is monosomic for 16p13.3-->16pter as well as for 22q11.21-->22pter. This individual has the clinical phenotype of
15 TSC (see Experimental Procedures); the most likely explanation is that the TSC2 locus located within 16p13.3 is deleted in the unbalanced karyotype.

 Further analysis revealed that the mother (77-2), and the daughter (77-3) with the balanced
20 translocation, have the clinical features of ADPKD (see Experimental Procedures), while the parents of 77-2 were cytogenetically normal, with no clinical features of TSC and no renal cysts on ultrasound examination (aged 67 and 82 years). Although kidney cysts can be a
25 feature of TSC, no other clinical signs of TSC were identified in 77-2 or 77-3, making it unlikely that the polycystic kidneys were due to TSC. We therefore investigated the possibility that the translocation disrupted the PKD1 locus in 16p13.3 and proceeded to
30 identify and clone the region containing the breakpoint.

 The 77 family was analysed with polymorphic markers from 16p13.3. Individual 77-4 was hemizygous for MS205.2 and GGG1, but heterozygous for SM6 and more
35 proximal markers, locating the translocation breakpoint

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between GGG1 and SM6 (see Figure 1a). Fluorescence in situ hybridisation (FISH) of a cosmid from the TSC2 region, CW9D (cosmid 1 in Figure 1a), to metaphase spreads showed that it hybridised to the der(22) chromosome of 77-2; placing the breakpoint proximal to CW9D and indicating that 77-4 was hemizygous for this region consistent with his TSC phenotype. DNA from members of the 77 family was digested with Cla I, separated by PFGE and hybridised with SM6; revealing a breakpoint fragment of ~ 100 kb in individuals with the der(16) chromosome (Figure 1c). The small size of this novel fragment enabled the breakpoint to be localised distal to SM6 in a region of just 60 kb (Figure 1a). A cosmid contig covering this region was therefore constructed (see Experimental Procedures for details). **The translocation breakpoint lies within a region duplicated elsewhere on chromosome 16p (16p13.1)**

It was previously noted that the region between CW21 and N54 (Figure 1a) was duplicated at a more proximal site on the short arm of chromosome 16 (Germino, et al., 1992; European Chromosome 16 Tuberous Sclerosis Consortium, 1993). Figure 2 shows that a cosmid, CW10III, from the duplicated region hybridises to two points on 16p; the distal, PKD1 region and a proximal site positioned in 16p13.1. The structure of the duplicated area is complex with each fragment present once in 16p13.3 re-iterated two-four times in 16p13.1 (see Figure 2). Cosmids spanning the duplicated area in 16p13.3 were subcloned (see Figure 3a and Experimental Procedures for details) and a restriction map was generated. A genomic map of the PKD1 region was constructed using a radiation hybrid, Hy145.19 which contains the distal portion of 16p but not the duplicate site in 16p13.1.

To localise the 77 translocation breakpoint, subclones from the target region were hybridised to 77-

- 20 -

2 DNA, digested with Cla I and separated by PFGE. Once
probes mapping across the breakpoint were identified
they were hybridised to conventional Southern blots of
77 family DNA. Figure 3b shows that novel BamH I
5 fragments were detected from the centromeric and
telomeric side of the breakpoint, which was localised
to the distal part of the probe 8S1 (Figure 3a).
Hence, the balanced translocation was not associated
with a substantial deletion, and the breakpoint was
10 located more than 20 kb proximal to the TSC2 locus
(Figure 3a). These results supported the hypothesis
that polycystic kidney disease in individuals with the
balanced translocation (77-2 and 77-3) was not due to
disruption of the TSC2 gene, but indicated that a
15 separate gene mapping just proximal to TSC2, was likely
to be the PKD1 gene.

**The polycystic breakpoint (PBP) gene is disrupted by
the translocation**

Localisation of the 77 breakpoint identified a
20 precise region in which to look for a candidate for the
PKD1 gene. During the search for the TSC2 gene we
identified other transcripts not associated with TSC
including a large transcript (~ 14 kb) partially
represented in the cDNAs 3A3 and AH4 which mapped to
25 the genomic fragments CW23 and CW21 (Figure 3a). The
orientation of the gene encoding this transcript had
been determined by the identification of a polyA tract
in the cDNA, AH4: the 3' end of this gene lies very
close to the TSC gene, in a tail to tail orientation
30 (European Chromosome 16 Tuberous Sclerosis Consortium,
1993). To determine whether this gene crossed the
translocation breakpoint genomic probes from within the
duplicated area and flanking the breakpoint were
hybridised to Northern blots. Probes from both sides of
35 the breakpoint, between JH5 and JH13 identified the 14
kb transcript (Figure 3a and see below for details).

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Therefore, this gene previously called 3A3, but now designated the PBP gene extended over the 77 breakpoint and consequently was a candidate for the PKD1 gene. A walk was initiated to increase the extent of the PBP cDNA contig and several new cDNAs were identified using probes from the single copy (non-duplicated) region (see Experimental Procedures for details). A cDNA contig was constructed which extended ~5.7 kb, including ~2 kb into the area that is duplicated (Figure 3a).

Expression of the PBP gene

Initial studies of the expression pattern of the PBP gene were undertaken with cDNAs that map entirely within the single copy region (e.g. AH4 and 3A3). Figure 4a shows that the ~14 kb transcript was identified by 3A3 in various tissue-specific cell lines. From this and other Northern blots we concluded that the PBP gene was expressed in all of the cell lines tested, although often at a low level. The two cell lines which showed the highest level of expression were fibroblasts and a cell line derived from an astrocytoma, G-CCM. Significant levels of expression were also obtained in cell lines derived from kidney (G401) and liver (Hep3B). Measuring the expression of the PBP gene in tissue samples by Northern blotting proved difficult because such a large transcript is susceptible to minor RNA degradation. However, initial results with an RNase protection assay, using a region of the gene located in the single copy area (see Experimental Procedures), showed a moderate level of expression of the PBP gene in tissue obtained from normal and polycystic kidney (data not shown). The widespread expression of the PBP gene is consistent with the systemic nature of ADPKD.

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Identification of transcripts that are partially homologous to the PBP transcript

New cDNAs were identified with the genomic fragments, JH4 and JH8, that map to the duplicated region (Figure 3a and see Experimental Procedures). However, when these cDNAs were hybridised to Northern blots a more complex pattern than that seen with 3A3 was observed. As well as the ~14 kb PBP transcript, three other, partially homologous transcripts were identified designated homologous gene-A (HG-A; ~ 21 kb), HG-B (~ 17 kb) and HG-C (8.5 kb) (Figure 4b). There were two possible explanations for these results, either the HG transcripts were alternatively spliced forms of the PBP gene, or the HG transcripts were encoded by genes located in 16p13.1. To determine the genomic location of the HG loci a fragment from the 3' end of one HG cDNA (HG-4/1.1) was isolated. HG-4/1.1 hybridised to all three HG transcripts, but not to the PBP transcript and on a hybrid panel it mapped to 16p13.1 (not the PKD1 area). These results show that all the HG transcripts are related to each other outside the region of homology with the PBP transcript and that the HG loci map to the proximal site (16p13.1).

25 An abnormal transcript associated with the 77 translocation

As the PBP gene was transcribed across the region disrupted by the 77 translocation breakpoint, in a proximal to distal direction on the chromosome (see Figure 3a) it was possible that a novel transcript originating from the PBP promotor would be found in this family. Figure 4c shows that using a probe to the PBP transcript that mapped mainly proximal to the breakpoint, a novel transcript of approximately 9 kb (PPP-77) derived from the der(16) product of the translocation was detected. Interestingly, the PBP-77

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transcript appears to be expressed at a higher level than the normal PBP product. These results confirmed that the 77 translocation disrupts the PBP gene and supports the hypothesis that this is the PKD1 gene.

5 **Mutations of the PBP gene in other ADPKD patients**

To prove that the PBP gene is the defective gene at the PKD1 locus, we analysed this region for mutations in patients with typical ADPKD. The 3' end of the PBP gene was most accessible to study as it maps
10 outside the duplicated area. To screen this region BamH I digests of DNA from 282 apparently unrelated ADPKD patients were hybridised with the probe 1A1H.6, (see Figure 3a). In addition, a large EcoR I fragment (41 kb) which contains a significant proportion of the
15 PBP gene was assayed by field inversion gel electrophoresis (FIGE) in 167 ADPKD patients, using the probe CW10. Two genomic rearrangements were identified in ADPKD patients by these procedures; each identified by both methods.

20 The first rearrangement was identified in patient OX875 (see Experimental Procedures for clinical details) who was shown to have a 5.5 kb genomic deletion within the 3' end of the PBP gene, producing a smaller transcript (PBP-875) (see Figures 5a, b and 3a
25 for details). This genomic deletion results in a ~3 kb internal deletion of the transcript with the ~500 bp adjacent to the polyA tail intact. In this family linkage of ADPKD to chromosome 16 could not be proven because although OX875 has a positive family history of
30 ADPKD there were no living, affected relatives. However, paraffin-embedded tissue from her affected father (now deceased) was available. We demonstrated that this individual had the same rearrangement as OX875 by PCR amplification of a 220bp fragment spanning
35 the deletion (data not shown). This result and analysis of two unaffected sibs of OX875, that did not

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have the deletion, showed that this mutation was transmitted with ADPKD.

The second rearrangement detected by hybridisation was a 2 kb genomic deletion within the PBP gene, in ADPKD patient OX114 (see Experimental Procedures for clinical details and Figures 5c and 3a). No abnormal PBP transcript was identified by Northern blot analysis, but using primers flanking the deletion (see Experimental Procedures) a shortened product was detected by RT-PCR (Figure 5c). This was cloned and sequenced and shown to have a frame-shift deletion of 446 bp (between base pair 1746 and 2192 of the sequence shown in Figure 7). OX114 is the only member of the family with ADPKD (she has no children) and ultrasound analysis of her parents at age 78 (father) and 73 years old (mother) showed no evidence of renal cysts. Somatic cell hybrids were produced from OX114 and the deleted chromosome was found to be of paternal origin by haplotype analysis. The father of OX114 is now deceased but analysis of DNA from the brother of OX114 (OX984) with seven microsatellite markers from the PKD1 region (see Experimental Procedures) showed that he shares the same paternal chromosome, in the PKD1 region, as OX114. Renal ultrasound revealed no cysts in OX984 at age 53 and no deletion was detected by DNA analysis (Figure 5c). Hence, the deletion in OX114 is a de novo event associated with the development of ADPKD. Although it is not possible to show that the ADPKD is chromosome 16-linked, the location of the PBP gene indicates that this is a de novo PKD1 mutation.

To identify more PKD1 associated mutations, single copy regions of the PBP gene were analysed by RT-PCR using RNA isolated from lymphoblastoid cell lines established from ADPKD patients. cDNA from 48 unrelated patients was amplified with the primer pair 3A3 C (see Experimental Procedures) and the product of 260 bp was

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analysed on an agarose gel. In one patient, OX32, an additional smaller product (125 bp) was identified, consistent with a deletion or splicing mutation. OX32 comes from a large family in which the disease can be traced through three generations. Analysis of RNA from two affected sibs of OX32 and his parents showed that the abnormal transcript segregates with PKD1 (Figure 5d).

Amplification of normal genomic DNA with the 3A3 C primers generates a product of 418 bp; sequencing showed that this region contains two small introns (5', 75 bp and 3', 83 bp) flanking a 135 bp exon. The product amplified from OX32 genomic DNA was normal in size, excluding a genomic deletion. However, heteroduplex analysis of that DNA revealed larger heteroduplex bands, consistent with a mutation within that genomic interval. The abnormal OX32, RT-PCR product was cloned and sequenced: this demonstrated that, although present in genomic DNA, the 135 bp exon was missing from the abnormal transcript. Sequencing of OX32 genomic DNA demonstrated a G-->C transition at +1 of the splice donor site following the 135 bp exon. This mutation was confirmed in all available affected family members by digesting amplified genomic DNA with the enzyme Bst NI: a site is destroyed by the base substitution. The splicing defect results in an in-frame deletion of 135 bp from the PBP transcript (3696 bp to 3831 bp of the sequence shown in Figure 7). Together, the three intragenic mutations confirm that the PBP gene is the defective gene at the PKD1 locus.

Deletions that disrupt the TSC2 and the PKD1 gene

We previously identified a deletion (WS-53) which disrupts the TSC2 gene and the PKD1 gene (European Chromosome 16 Tuberous Sclerosis Consortium, 1993), although its full proximal extent was not determined. Further study has shown that the deletion extends ~ 100

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kb (see Figure 6 for details) and deletes most if not all of the PKD1 gene. This patient has TSC but also has unusually severe polycystic disease of the kidneys. Other patients with a similar phenotype have also been under investigation. Deletions involving both TSC2 and PKD1 were identified and characterised in six patients in whom TSC was associated with infantile polycystic kidney disease. As well as the deletion in WS-53, those in WS-215 and "S-250 also extended proximally well beyond the known distribution of PKD1 and probably delete the entire gene. The deletion in WS-194 extended over the known extend of PKD1, but not much further proximally, while the proximal breakpoints in WS-219 and WS-227 lay within PKD1 itself. Northern analysis of case WS-219 with probe JH8, which lies outside the deletion, showed a reduced level of the PKD1 transcript but no evidence of an abnormally sized transcript (data now shown). Analysis of samples from the clinically unaffected parents of patients WS-53, WS-215, WS-219, WS-227 and WS-250 showed the deletions in these patients to be de novo. The father of WS-194 was unavailable for study.

In a further case (WS-212), renal ultrasound showed no cysts at four years of age but a deletion was identified which removed the entire TSC2 gene and deleted an XbaI site which is located 42bp 5' to the polyadenylation signal of PKD1. To determine the precise position of the proximal breakpoint in PKD1, a 587bp probe from the 3' untranslated region (3'UTRP) was hybridised to XbaI digested DNA. A 15kb XbaI breakpoint fragment was detected with an approximately equal intensity to the normal fragment of 6kb, indicating that most of the PKD1 3'UTR was preserved on the mutant chromosome. Evidence that a PKD1 transcript is produced from the deleted chromosome in WS-212 was obtained by 3' rapid identification of cDNA ends (RACE)

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with a novel, smaller product generated from WS-212 cNDA. Characterisation of this product showed that polyadenylation occurs 546bp 5' to the normal position, within the 3'UTR of PKD1 (231bp 3' to the stop codon at 5073bp of the described PKD1 sequence¹⁴). A transcript with an intact open reading frame is thus produced from the deleted WS-212 chromosome. It is likely that a functional PKD1 protein is produced from this transcript, explaining the lack of cystic disease in this patient. The sequence preceeding the novel site of polyA addition is: AGTCAGTAAATTTATATGGTGTTAAAATGTG(A)_n. Although not conforming precisely to the consensus of AATAAA, it is likely that part of this AT rich region acts as an alternative polyadenylation signal if, as in this case, the normal signal is deleted (a possible sequence is underlined).

The WS-212 deletion is 75kb between SM9-CW9 distally and the PKD1 3'UTR proximally. The WS-215 deletion is 160kb between CW15 and SM6-JH17. WS-194 has 65kb deleted between CW20 and CW10-CW36. WS-227 has a 50kb deletion between CW20 and JH11 and WS-219 has a 27kb deletion between JH1 and JH6. The distal end of the WS-250 deletion is in CW20 but the precise location of the proximal end is not known. However, the same breakpoint fragment of 320kb is seen with PvuI-digested DNA using probes on adjacent PvuI fragments, CE18 (which normally detects a 245kb fragment) and BLu24 (235kb). Hence this deletion can be estimated ~160kb. b. PFGE analysis of the deletion in WS-219. MluI digested DNA from a normal control (N) and WS-219 probed with the clones H2, JH1, CW21 and CW10 which detect an ~130kb fragment in normal individuals. CW10 also detects a much smaller fragment from the duplicated region situated more proximally on 16p. A novel fragment of ~100kb is seen in WS-219 with

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probes H2 and CW10 which flank the deletion in this patient. JH1 is partially deleted but detects the novel band weakly. The aberrant fragment is not detected by CW-21, which is deleted on the mutant chromosome. BamH1 digested DNA of normal control (N) and WS-219 separated by conventional gel electrophoresis and hybridised to probes JH1 and JH6 which flank the deletion. The same breakpoint fragment of ~3kb is seen with both probes, consistent with a deletion of ~27kb ending within the BamH1 fragments seen by these probes.

Two further deletions

In addition we have characterised two further mutations of this gene which were identified in typical PKD1 families. In both cases the mutation is a deletion in the 75bp intron amplified by the primer pair 3A3C (European Polycystic Kidney Disease Consortium, 1994). The deletions are of 18bp and 20bp, respectively, in the patients 461 and OX1054. Although these deletions do not disrupt the highly conserved sequences flanking the exon/intron boundaries, they do result in aberrant splicing of the transcript. In both cases, two abnormal mRNAs are produced, one larger and one smaller than normal. Sequencing of these cDNAs showed that the larger transcript includes the deleted intron, and so has an in-frame insertion of 57bp in 461, while OX1054 has a frameshift insertion of 55bp. The smaller transcript is due to activation of a cryptic splice site in the exon preceding the deleted intron and results in an in-frame deletion of 66bp in both patients. The demonstration of two additional mutations of this gene in PKD1 patients further confirms that this is the PKD1 gene.

Characterisation of the PKD1 gene

To characterise the PKD1 gene further, evolutionary conservation was analysed by

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blotting'. Using probes from the single copy, 3' region (3A3) and from the duplicated area (JH4, JH8) the PKD1 gene was conserved in other mammalian species, including horse, dog, pig and rodents (data not shown).

5 No evidence of related sequences were seen in chicken, frog or drosophila by hybridisation at normal stringency. The degree of conservation was similar when probes from the single copy or the duplicated region were employed.

10 The full genomic extent of the PKD1 gene is not yet known, although results obtained by hybridisation to Northern blots show that it extends from at least as far as JH13. Several CpG islands have been localised 5' of the known extent of the PKD1 gene (Figure 6),
15 although there is no direct evidence that any of these are associated with this gene.

The cDNA contig extending 5631 bp to the 3' end of the PKD1 transcript was sequenced; where possible more than one cDNA was analysed and in all regions both
20 strands were sequenced (Figure 7). We estimated that this accounts for ~40% of the PKD1 transcript. An open reading frame was detected which runs from the 5' end of the region sequenced and spans 4842 bp, leaving a 3' untranslated region of 789 bp which contains the
25 previously described microsatellite, KG8 (Peral, et al., 1994; Snarey, et al., 1994). A polyadenylation signal is present at nucleotides 5598-5603 and a polyA tail was detected in two independent cDNAs (AH4 and AH6) at position, 5620. Comparison with the cDNAs HG-
30 4 and 11BHS21, which are encoded by genes in the duplicate, 16p13.1 region, show that 1866 bp at the 5' end of the partial PKD1 sequence shown in Figure 7 lies within the duplicated area. The predicted amino acid sequence from the available open reading frame extends
35 1614 residues, and is shown in Figure 7. A search of the swissprot and NBRF data bases with the available

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protein sequence, using the Blast programme (Altschul, et al., 1990) identified only short regions of similarity (notably, between amino-acids 690-770 and 1390-1530) to a diverse group of proteins; no highly significant areas of homology were recognised. The importance of the short regions of similarity is unclear as the search for protein motifs with the ProSite Programme did not identify any recognised functional protein domains within the PKD1 gene.

The task of identifying and characterising the PKD1 gene has been more difficult than for other disorders because more than three quarters of the gene is embedded in a region of DNA that is duplicated elsewhere on chromosome 16. This segment of 40-50 kb of DNA, present as a single copy in the PKD1 area (16p13.3), is re-iterated as several divergent copies in the more proximal region, 16p13.1. This proximal site contains three gene loci (HG-A, -B and -C) that each produce polyadenylated mRNAs and share substantial homology to the PKD1 gene; it is not known whether these partially homologous transcripts are translated into functional proteins.

Although gene amplification is known as a major mechanism for creating protein diversity during evolution, the discovery of a human disease locus embedded within an area duplicated relatively recently is a new observation. In this case because of the recent nature of the reiteration the whole duplicated genomic region retains a high level of homology, not just the exons. The sequence of events leading to the duplication and which sequence represents the original gene locus are not yet clear. However, early evidence of homology of the 3' ends of the three HG transcripts which are different from the 3' end of the PKD1 gene indicated that the loci in 16p13.1 have probably arisen

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by further reiteration of sequences at this site, after it separated from the distal locus.

To try to overcome the duplication problem we have employed an exon linking approach using RNA isolated from a radiation hybrid, Hy145.19, that contains just the PKD1 part of chromosome 16, and not the duplicate site in 16p13.1. Hence, this hybrid produces transcripts from the PKD1 gene but not from the homologous genes (HG-A, HG-B and HG-C). We have also sequenced much of the genomic region containing the PKD1 gene, from the cosmid JH2A, and have sequenced a number of cDNAs from the HG locus. To determine the likely position of PKD1 exons in the genomic DNA we compared HG cDNAs, (HG-4 and HG-7) to the genomic sequence. We then designed primers with sequences corresponding to the genomic DNA, to regions identified by the HG exons and employing cDNA generated from the hybrid Hy145.19, we amplified sections of the PKD1 transcript. The polymerase Pfu was used to minimise incorporation errors. These amplified fragments were then cloned and sequenced. The PDK1 cDNA contig whose sequence is shown in Figure 10 is made up of (3'-5') the original 5.7 kb of sequence shown in Figure 7, and the cDNAs: gap α 22 (890 bp), gap gamma (872 bp), a section of genomic DNA from the clone JH8 (2,724 bp) which corresponds to a large exon, S1-S3 (733 bp), S3-S4 (1,589 bp) and S4-S13 (1,372 bp). Together these make a cDNA of 13,807 bp with the extreme 5' end of the transcript still uncharacterised. When these cDNAs from the PKD1 contig were sequenced an open reading frame was found to run from the start of the contig to the previously-identified stop codon, a region of 13,018 bp. The predicted protein encoded by the PKD1 transcript is also shown in Figure 10 and has 4,339 amino acid residues.

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We have therefore compelling evidence that mutations of the PKD1 gene give rise to the typical phenotype of ADPKD. The location of this gene within the PKD1 candidate region and the available genetic evidence from the families with mutations show that this is the PKD1 gene. The present invention therefore includes the PKD1 gene itself and the six PKD1-associated mutations which have been described: a de novo translocation, which was subsequently transmitted with the phenotype; two intragenic deletions (one a de novo event); two further deletions; and a splicing defect.

It has previously been argued that PKD1 could be recessive at the cellular level, with a second somatic mutation required to give rise to cystic epithelium (Reeders, 1992). This "two hit" process is thought to be the mutational mechanism giving rise to several dominant diseases, such as neurofibromatosis (Legius, et al., 1993) and tuberous sclerosis (Green, et al., 1994) which result from a defect in the control of cellular growth. If this were the case, however, we might expect that a proportion of constitutional PKD1 mutations would be inactivating deletions as seen in these other disorders.

The location of the PKD1 mutations may, however, reflect some ascertainment bias as it is this single copy area which has been screened most intensively for mutations. Nevertheless, no additional deletions were detected when a large part of the gene was screened by FIGE, and studies by PFGE showed no large deletions of this area in 75 PKD1 patients. It is possible that the mutations detected so far result in the production of an abnormal protein which causes disease through a gain of function. However, it is also possible that these mutations eliminate the production of functional protein from this chromosome and result in the PKD1

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phenotype by haploinsufficiency, or only after loss of the second PKD1 homologue by somatic mutation.

At least one mutation which seems to delete the entire PKD1 gene has been identified (WS-53) but in this case it also disrupts the adjacent TSC2 gene and the resulting phenotype is of TSC with severe cystic kidney disease. Renal cysts are common in TSC so that the phenotypic significance of deletion of the PKD1 gene in this case is difficult to assess. It is clear that not all cases of renal cystic disease in TSC are due to disruption of the PKD1 gene; chromosome 9 linked TSC (TSC1) families also manifest cystic kidneys and we have analysed many TSC2 patients with kidney cysts who do not have deletion of the PKD1 gene.

Preliminary analysis of the PKD1 protein sequence has highlighted two regions which provide some clues to the possible function of the PKD1 gene. At the extreme 5' end of the characterised region are two leucine-rich repeats (LRRs) (amino acids 29-74) flanked by characteristic amino flanking (amino acids 6-28) and carboxy flanking sequences (amino acids 76-133) (Rothberg et al, 1990). LRRs are thought to be involved in protein-protein interactions (Kobe and Deisenhofer, 1994) and the flanking sequences are only found in extracellular proteins. Other proteins with LRRs flanked on the amino and carboxy sides are receptors or are involved in adhesion or cellular signalling. Further 3' on the protein (amino acids 350-515) is a C-type lectin domain (Curtis et al, 1992). This indicates that this region binds carbohydrates and is also likely to be extracellular. These two regions of homology indicate that the 5' part of the PKD1 protein is extracellular and involved in protein-protein interactions. It is possible that this protein is a constituent of, or plays a role in assembling, the extracellular matrix (ECM) and may act

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as an adhesive protein in the ECM. It is also possible that the extracellular portion of this protein is important in signalling to other cells. The function of much of the PKD1 protein is still not fully known but the presence of several hydrophobic regions indicates that the protein may be threaded through the cell membrane.

Familial studies indicate that de novo mutations probably account for only a small minority of all ADPKD cases; a recent study detected 5 possible new mutations in 209 families (Davies, et al., 1991). However, in our study one of three intragenic mutations detected was a new mutation and the PKD1 associated translocation was also a de novo event. Furthermore, the mutations detected in the two familial cases do not account for a significant proportion of the local PKD1. The OX875 deletion was only detected in 1 of 282 unrelated cases, and the splicing defect was seen in only 1 of 48 unrelated cases. Nevertheless, studies of linkage disequilibrium have found evidence of common haplotypes associated with PKD1 in a proportion of some populations (Peral, et al., 1994; Snarey, et al., 1994) suggesting that common mutations will be identified.

Once a larger range of mutations have been characterised it will be possible to evaluate whether the type and location of mutation determines disease severity, and if there is a correlation between mutation and extra-renal manifestations. Previous studies have provided some evidence that the risk of cerebral aneurysms 'runs true' in families (Huston, et al., 1993) and that some PKD1 families exhibit a consistently mild phenotype (Ryynanen, et al., 1987). A recent study has concluded that there is evidence of anticipation in ADPKD families, especially if the disease is transmitted through the mother (Fink, et

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al., 1994). Furthermore, analysis of families with early manifestation of ADPKD show that there is a significant intra-familial recurrence risk and that childhood cases are most often transmitted maternally (Fink, et al., 1993; Zerres, et al., 1993). This pattern of inheritance is reminiscent of that seen in diseases in which an expanded trinucleotide repeat was found to be the mutational mechanism (reviewed in Mandel, 1993). However, no evidence for an expanding repeat correlating with PKD1 has been found in this region although such a sequence cannot be excluded.

There is ample evidence that early presymptomatic diagnosis of PKD1 is helpful because it allows complications such as hypertension and urinary tract infections to be monitored and treated quickly (Ravine, et al., 1991). The identification of mutations within a family will allow rapid screening of that and other families with the same mutation. However, genetic linkage analysis is likely to remain important for presymptomatic diagnosis. The accuracy and ease of linkage based diagnosis will be improved by the identification of the PKD1 gene as a microsatellite lies in the 3' untranslated region of this gene (KG-8) and several CA repeats are located 5' of the gene (see Figure 1a and 6; Peral, et al., 1994; Snarey, et al., 1994).

Experimental Procedures

Clinical Details of Patients

Family 77

77-2 and 77-3 are 48 and 17 years old, respectively, and have typical ADPKD. Both have bilateral polycystic kidneys and 77-2 has impaired renal function. Neither patient manifests any signs of TSC (apart from cystic kidneys) on clinical and ophthalmological examination or by CT scan of the brain.

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77-4 is 13 years old, severely mentally retarded and has multiple signs of TSC including adenoma sebaceum, depigmented macules and periventricular calcification on CT scan. Renal ultrasound reveals a small number of bilateral renal cysts.

ADPKD patients

OX875 developed ESRD from ADPKD, aged 46. Progressive decline in renal function had been observed over 17 years; ultrasound examinations documented enlarging polycystic kidneys with less extensive hepatic cystic disease. Both kidneys were removed after renal transplantation and pathological examination showed typical advanced cystic disease in kidneys weighing 1920g and 3450g (normal average 120g).

OX114 developed ESRD from ADPKD aged 54: diagnosis was made by radiological investigation during an episode of abdominal pain aged 25. A progressive decline in renal function and the development of hypertension was subsequently observed. Ultrasonic examination demonstrated enlarged kidneys with typical cystic disease, with less severe hepatic involvement.

OX32 is a member of a large kindred affected by typical ADPKD in which several members have developed ESRD. The patient himself has been observed for 12 years with progressive renal failure and hypertension following ultrasonic demonstration of polycystic kidneys.

No signs of TSC were observed on clinical examination of any of the ADPKD patients.

DNA Electrophoresis and Hybridisation

DNA extraction, restriction digests, electrophoresis, Southern blotting, hybridisation and washing were performed by standard methods or as previously described (Harris, et al., 1990). FIGE was performed with the Biorad FIGE Mapper using programme 5 to separate fragments from 25-50 kb. High molecular

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weight DNA for PFGE was isolated in agarose blocks and separated on the Biorad CHEF DRII apparatus using appropriate conditions.

Genomic DNA probes and somatic cell hybrids

5 Many of the DNA probes used in this study have been described previously: MS205.2 (D16S309; Royle, et al., 1992); GGG1 (D16S259; Germino, et al., 1990); N54 (D16S139; Himmelbauer, et al., 1991); SM6 (D16S665), CW23, CW21, and JH1 (European Chromosome 16 Tuberous
10 Sclerosis Consortium, 1993). Microsatellite probes for haplotype analysis were KG8 and W5.2 (Snarey, et al., 1994) SM6, CW3 and CW2, (Peral, et al., 1994), 16AC2.5 (Thompson, et al., 1992); SM7 (Harris, et al., 1991), VK5AC (Aksentijevich, et al., 1993).

15 New probes isolated during this study were: JH4, JH5, JH6, 11 kb, 6 kb and 6 kb BamH I fragments, respectively, and JH13 and JH14, 4 kb and 2.8 kb BamH I-EcoR I fragments, respectively, all from the cosmid JH2A; JH8 and JH10 are 4.5 kb and 2 kb Sac I fragments,
20 respectively and JH12 a 0.6 Sac I-BamH I fragment, all from JH4; 8S1 and 8S3 are 2.4 kb and 0.6 kb Sac II fragments, respectively, from JH8; CW10 is a 0.5 kb Not I-Mlu I fragment of SM25A; JH17 is a 2 kb EcoR I fragment of NM17.

25 The somatic cell hybrids N-OH1 (Germino, et al., 1990), P-MWH2A (European Chromosome 16 Tuberous Sclerosis Consortium, 1993) and Hyl45.19 (Himmelbauer, et al., 1991) have previously been described. Somatic cell hybrids containing the paternally derived (BP2-10)
30 and maternally derived (BP2-9) chromosomes from OX114 were produced by the method of Deisseroth and Hendrick (1979).

Constructing a cosmid contig

35 Cosmids were isolated from chromosome 16 specific and total genomic libraries, and a contig was constructed using the methods and libraries previously

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described (European Chromosome 16 Tuberous Sclerosis Consortium, 1993). To ensure that cosmids were derived from the 16p13.3 region (not the duplicate 16p13.1 area) initially, probes from the single copy area were used to screen libraries (e.g. CW21 and N54). Two cosmids mapped entirely within the area duplicated, CW10III and JC10.2B. To establish that these were from the PKD1 area, they were restriction mapped and hybridised with the probe CW10. The fragment sizes detected were compared to results obtained with hybrids containing only the 16p13.3 area (Hyl45.19) or only the 16p13.1 region (P-MWH2A).

FISH

FISH was performed essentially as previously described (Buckle and Rack, 1993). The hybridisation mixture contained 100 ng of biotin-II-dUTP labelled cosmid DNA and 2.5 mg human Cot-1 DNA (BRL), which was denatured and annealed at 37°C for 15 min prior to hybridisation at 42°C overnight. After stringent washes the site of hybridisation was detected with successive layers of fluorescein-conjugated avidin (5 mg/ml) and biotinylated anti-avidin (5 mg/ml) (Vector Laboratories). Slides were mounted in Vectashield (Vector Laboratories) containing 1 mg/ml propidium iodide and 1 mg/ml 4', 6-diamidino-2-phenylindole (DAPI), to allow concurrent G-banded analysis under UV light. Results were analysed and images captured using a Bio-Rad MRC 600 confocal laser scanning microscope.

cDNA screening and characterisation

Foetal brain cDNAs libraries in 1 phage (Clonetech and Stratagene) were screened by standard methods with genomic fragments in the single copy area (equivalent to CW23 and CW21) or with a 0.8 kb Pvu II-Eco RI single copy fragment of AH3. Six PBP cDNAs were characterised including two previously described, AH4 (1.7 kb) , 3A3 (2.0 kb) (European Chromosome 16 Tuberous Sclerosis

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Consortium, 1993), and four novel cDNAs AH3 (2.2 kb), AH6 (2.0 kb), A1C (2.2 kb) and B1E (2.9 kb). A Striatum library (Stratagene) was screened with JH4 and a HG-C cDNA, 11BHS21 (3.8 kb) was isolated; 21P.9 is a 0.9 kb Pvu II-EcoR I subclone of this cDNA. A HG-A or HG-B cDNA, HG-4 (7 kb) was also isolated by screening the foetal brain library (Stratagene) with JH8. HG-4/1.1 is a 1.1 kb Pvu II-EcoR I fragment from the 3' end of HG-4. 1A1H.6 is a 0.6 kb Hind III-EcoR I subclone of a TSC2 cDNA, 1A-1 (1.7 kb), which was isolated from the Clonetech library. Each cDNA was subcloned into Bluescript and sequenced utilising a combination of sequential truncation and oligonucleotide primers using DyeDeoxy Terminators (Applied Biosystems) and an ABI 373A DNA Sequencer (Applied Biosystems) or by hand with 'Sequenase' T7 DNA polymerase (USB).

RNA Procedures

Total RNA was isolated from cell lines and tissues by the method of Chomczynski and Sacchi (1987) and enrichment for mRNA made using the PolyAT tract mRNA Isolation System (Promega). For RNA electrophoresis 0.5% agarose denaturing formaldehyde gels were used which were Northern blotted, hybridised and washed by standard procedures. The 0.24 - 9.5 kb RNA (Gibco BRL) size standard was used and hybridisation of the probe (1-9B3) to the 13 kb Utrophin transcript (Love, et al., 1989) in total fibroblast RNA was used as a size marker for the large transcripts.

RT-PCR was performed with 2.5 mg of total RNA by the method of Brown et al (1990) with random hexamer primers, except that AMV-reverse transcriptase (Life Sciences) was employed. To characterise the deletion of the PBP transcript in OX114 we used the primers :

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AH3 F9 5' TTT GAC AAG CAC ATC TGG CTC TC 3'
AH3 B7 5' TAC ACC AGG AGG CTC CGC AG 3'

5 in a DMSO containing PCR buffer (Dodé, et al., 1990) with 0.5 mM MgCl₂ and 36 cycles of: 94°C, 1 min; 61°C, 1 min; 72°C, 2 min plus a final extension of 10 min. The 3A3 C primers used to amplify the OX32 cDNA and DNA were:

3A3 C1 5' CGC CGC TTC ACT AGC TTC GAC 3'
10 3A3 C2 5' ACG CTC CAG AGG GAG TCC AC 3'

These were employed in a PCR buffer and cycle previously described (Harris, et al., 1991) with 1mM MgCl₂ and an annealing temperature of 61°C.

15 PCR products for sequencing were amplified with Pfu-1 (Stratagene) and ligated into the Srf-1 site in PCR-Script (Stratagene) in the presence of Srf-1.

RNAse protection

20 Tissues from normal and end-stage polycystic kidneys were immediately homogenised in guanidinium thiocyanate. RNA was purified on a cesium chloride gradient and 30 mg total RNA was assayed by RNAse protection by the method of Melton, et al., (1984) using a genomic template generated with the 3A3, C primers.

25 Heteroduplex Analysis

Heteroduplex analysis was performed essentially as described by Keen et al (1991). Samples were amplified from genomic DNA with the 3A3, C primers, heated at 95°C for 5 minutes and incubated at room temperature for at least 30 minutes before loading on a Hydrolink gel (AT Biochem). Hydrolink gels were run for 12-18 hours at 250V and fragments observed after staining with ethidium bromide.

Extraction and amplification of paraffin-embedded DNA

35 DNA from formalin fixed, paraffin wax embedded kidney tissue was prepared by the method of Wright and

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Manos (1990), except that after proteinase K digestion overnight at 55°C, the DNA was extracted with phenol plus chloroform before ethanol precipitation. Approximately 50 ng of DNA was used for PCR with 1.5 mM MgCl₂ and 40 cycles of 94°C for 1 min, 59°C for 1 min and 72°C for 40 s, plus a 10 min extension at 72°C. The oligonucleotide primers designed to amplify across the genomic deletion of OX875 were:

AH4F2 : 5' - GGG CAA GGG AGG ATG ACA AG - 3'
10 JH14B3 : 5' - GGG TTT ATC AGC AGC AAG CGG - 3'

which produced a product of ~ 220 bp in individuals with the OX875 deletion.

3'RACE analysis of WS-212

3' RACE was completed essentially as described (European Polycystic Kidney Disease Consortium (1994)). Reverse transcription was performed with 5µg total RNA with 0.5µg of the hybrid dT₁₇ adapter primer using conditions previously described (Fronman et al., (1988)). A specific 3' RACE product was amplified with the primer F5 and adapter primer in 0.5mM MgCl₂ with the program: 57°C, 60s; 72°C, 15 minutes and 30 cycles of 95°C, 40s; 57°C, 60s; 72°C, 60s plus 72°C, 10 minutes. The amplified product was cloned using the TA cloning system (Invitrogen) and sequenced by conventional methods.

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15

CLAIMS

1. An isolated, purified or recombinant nucleic acid sequence comprising:-

- (a) a PKD1 gene or its complementary strand,
- 5 (b) a sequence substantially homologous to, or capable of hybridising to, a substantial portion of a molecule defined in (a) above,
- (c) a fragment of a molecule defined in (a) or (b) above.

10 2. A sequence according to claim 1, wherein the PKD1 gene has the partial nucleic acid sequence according to Figure 7 and/or 10.

3. A sequence according to claim 1 or claim 2 comprising a DNA molecule selected from:

- 15 (a) a PKD1 gene or its complementary strand,
- (b) a sequence substantially homologous to, or capable of hybridising to, a substantial portion of a molecule defined in (a) above,
- (c) a molecule coding for a polypeptide having the
- 20 partial sequence of Figure 7,
- (d) genomic DNA corresponding to a molecule in (a) above; and
- (e) a fragment of a molecule defined in any of (a), (b), (c) or (d) above.

25 4. A nucleic acid sequence comprising a mutant PKD1 gene, selected from those wherein:-

- (a) [OX114] base pairs 1746-2192 as defined in

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Figure 7 are deleted (446bp);

(b) [OX32] base pairs 3696-3831 as defined in Figure 7 are deleted by a splicing defect;

(c) [OX875] about 5.5kb flanked by the two XbaI sites shown in Figure 3a are deleted and the EcoRI site separating the CW10 (41kb) and JH1 (18kb) sites is thereby absent; and

(d) [WS53] about 100kb extending between the JH1 and CW21 and the SM6 and JH17 sites shown in Figure 6 and the PKD1 gene is thereby absent.

5. A nucleic acid sequence comprising a mutant PKD1 gene selected from those wherein-

(a) [461] about 18bp are deleted in the 75bp intron amplified by the primer pair 3A3C insert at position 3696 of the 3' sequence as shown in Figure 11;

(b) [OX1054] about 20bp are deleted in the 75bp intron amplified by the primer pair 3A3C insert at position 3696 of the 3' sequence as shown in Figure 11;

(c) [WS212] about 75kb are deleted between SM9-CW9 distally and the PKD1 3'UTR proximally as shown in Figure 12;

(d) [WS-215] about 160kb are deleted between CW20 and CW10-CW36 as shown in Figure 12;

(e) [WS-227] about 50kb are deleted between CW20 and JH11 as shown in Figure 12;

(f) [WS-219] about 27kb are deleted between JH1 and JH6 as shown in Figure 12; and

(g) [WS-250] about 160kb are deleted between WC20

and BLu24 as shown in Figure 12.

(h) [WS194] a deletion of about 65kb between CW20 and CW10.

6. An RNA molecule comprising an RNA sequence
5 corresponding to a DNA sequence according to any of claims 1 to 5.

7. An RNA molecule according to claim 6, wherein the
molecule is the transcript referenced PKD1 and identifiable
from the restriction map of Figure 3a and having a sequence
10 of about 14 KB.

8. A nucleic acid probe having a sequence according to
any of the preceding claims and optionally including a
label.

9. A nucleic acid sequence according to any preceding
15 claim, wherein the nucleic acid sequence encoding PKD1 is
operably linked to transcriptional and/or translational
expression signals.

10. An isolated, purified or recombinant polypeptide
comprising a PKD1 protein or a mutant or variant thereof or
20 encoded by a sequence according to any of claims 1 to 9 or
a variant thereof having substantially the same activity as
the PKD1 protein.

11. A polypeptide according to claim 10, wherein the
PKD1 protein has the amino acid sequence according to the
25 partial amino acid sequence of Figure 7 and/or Figure 10.

12. An anti-PKD1 antibody or a labelled anti-PKD1
antibody.

13. A method for screening a subject to determine

whether said subject is a PKD1-associated disorder carrier or a patient having a PKD1-associated disorder, which method comprises detecting the presence of and/or evaluating the characteristics of PKD1 DNA, PKD1 RNA and/or PKD1 polypeptide in a biological sample from said patient.

14. A method according to claim 13 which is or includes detecting and/or evaluating whether the PKD1 DNA is mutated, deleted, aberrant or otherwise abnormal, or is not expressing normal PKD1 protein.

10 15. A method according to claim 13 or claim 14, wherein the detection and/or evaluation includes the step of comparing the results thereof with results obtained using a mutated sequence according to claim 4 or claim 5.

16. A method according to any of claims 13 to 15, wherein said screening includes applying a nucleic acid amplification process to said sample to amplify a fragment of the PKD1 DNA or cDNA corresponding to the PKD1 RNA.

17. A method according to claim 16, wherein said nucleic acid amplification process uses at least one of the following sets of primers as identified herein:-

AH3 F9 : AH3 B7

3A3 C1 : 3A3 C2

AH4 F2 : JH14 B3

18. A method according to any of claims 13 to 17 which comprises digesting said sample to EcoR1 fragments and hybridising with a DNA probe which hybridises to the EcoR1 fragment identified (A) in Figure 3(a).

19. A method according to claim 18, wherein said DNA

probe comprises the DNA probe CW10 identified herein.

20. A method according to any of claims 13 to 17 which comprises digesting said sample to provide BamHI fragments hybridising with a DNA probe which hybridises to the BamHI
5 fragment identified (B) in Figure 3(a).

21. A method according to claim 20, wherein said DNA probe comprises the DNA probe 1A1H.6 identified herein.

22. A vector (such as Bluescript (available from Stratagene)) comprising the nucleic acid sequence of any of
10 claims 1 to 9.

23. A host cell (such as E. coli strain SL-1 Blue (available from Stratagene)) transfected or transformed with a vector according to claim 22.

24. The use of a vector according to claim 23 or a
15 nucleic acid sequence according to any of claims 1 to 11 in gene therapy and/or in the preparation of an agent for treating or preventing a PKD1-associated disorder.

25. A method of treating or preventing a PKD1-associated disorder which method comprises administering to
20 a patient in need thereof a functional PKD1 gene to affected cells in a manner that permits expression of PKD1 protein therein and/or a transcript produced from a mutated chromosome such as the deleted WS-212 chromosome which is capable of expressing functional PKD1 protein therein.

26. A diagnostic kit for carrying out a method according
25 to any of claims 13 to 21, comprising nucleic acid primers for amplifying a fragment of a sequence according to any of Claims 1 to 9.

27. A diagnostic kit according to claim 26, wherein the nucleic acid primers comprise at least one of the following sets:

AH3 F9 : AH3 B7

5 3A3 C1 : 3A3 C2

AH4 F2 : JH14 B3

28. A diagnostic kit for carrying out a method according to claim 18, including one or more substances for digesting a sample to provide EcoRI fragments and a DNA probe as
10 defined in claim 19.

29. A diagnostic kit for carrying out a method according to claim 20, including one or more substances for digesting a sample to provide BamHI fragments and a DNA probe as defined in claim 21.

15 30. A diagnostic kit for carrying out a method for determining whether said subject is a PKD1-associated disorder carrier or a patient having a PKD1-associated disorder, which includes a nucleic acid probe capable of hybridising to a sequence according to any of claims 1 to
20 11.

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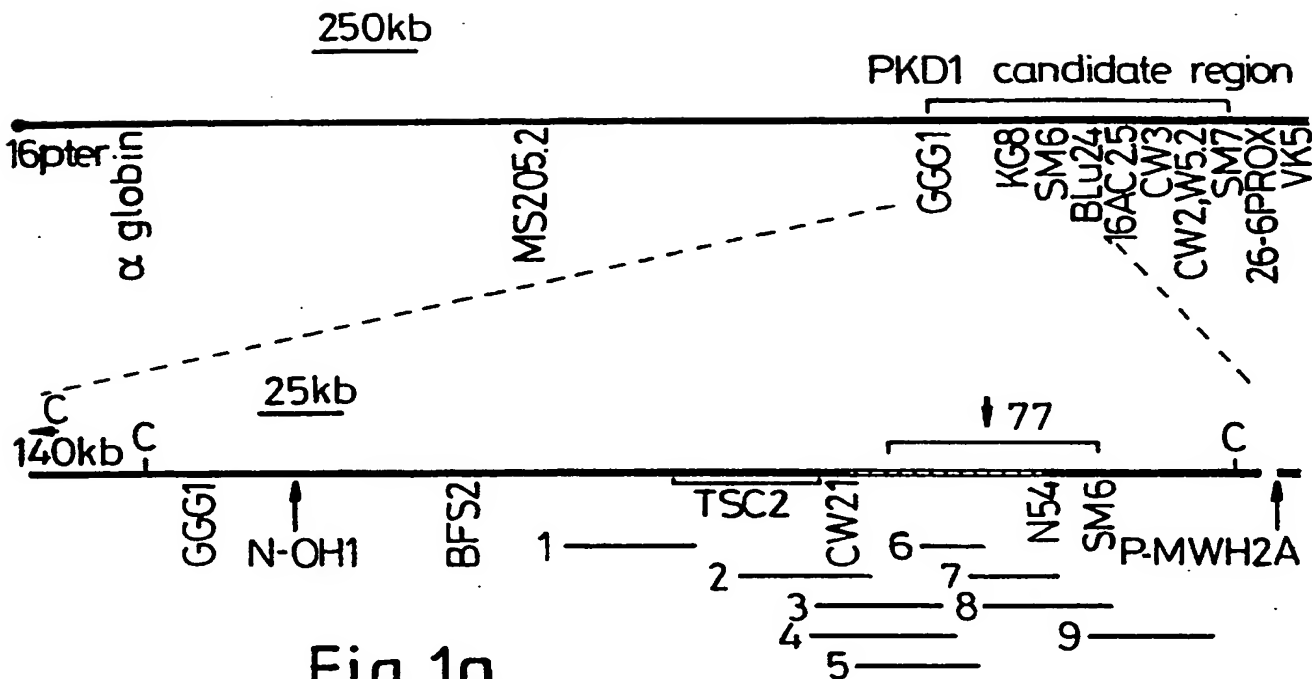


Fig. 1a

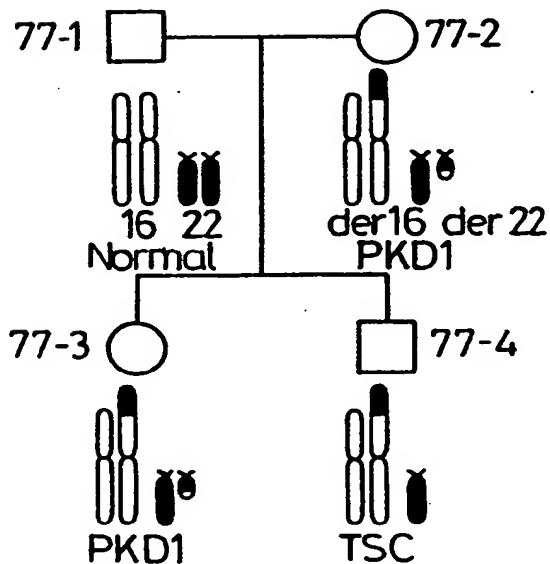


Fig. 1b

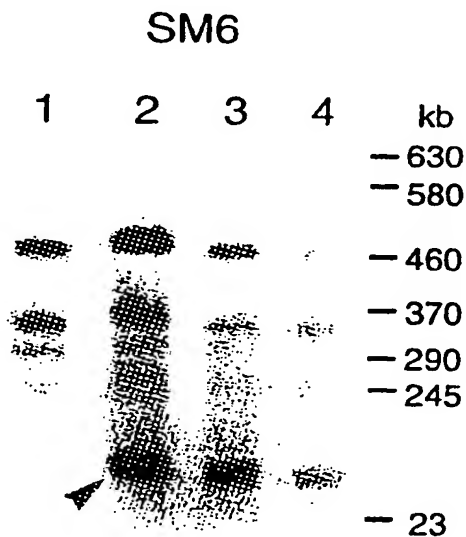


Fig. 1c

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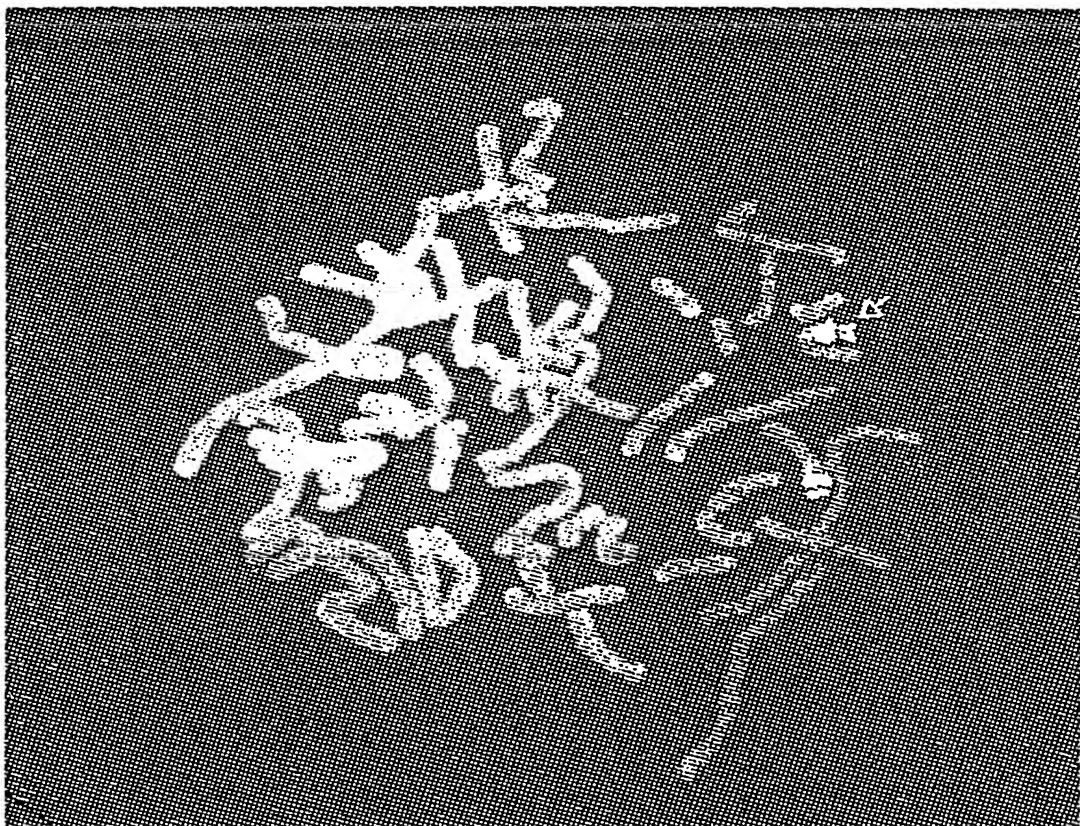


Fig. 2

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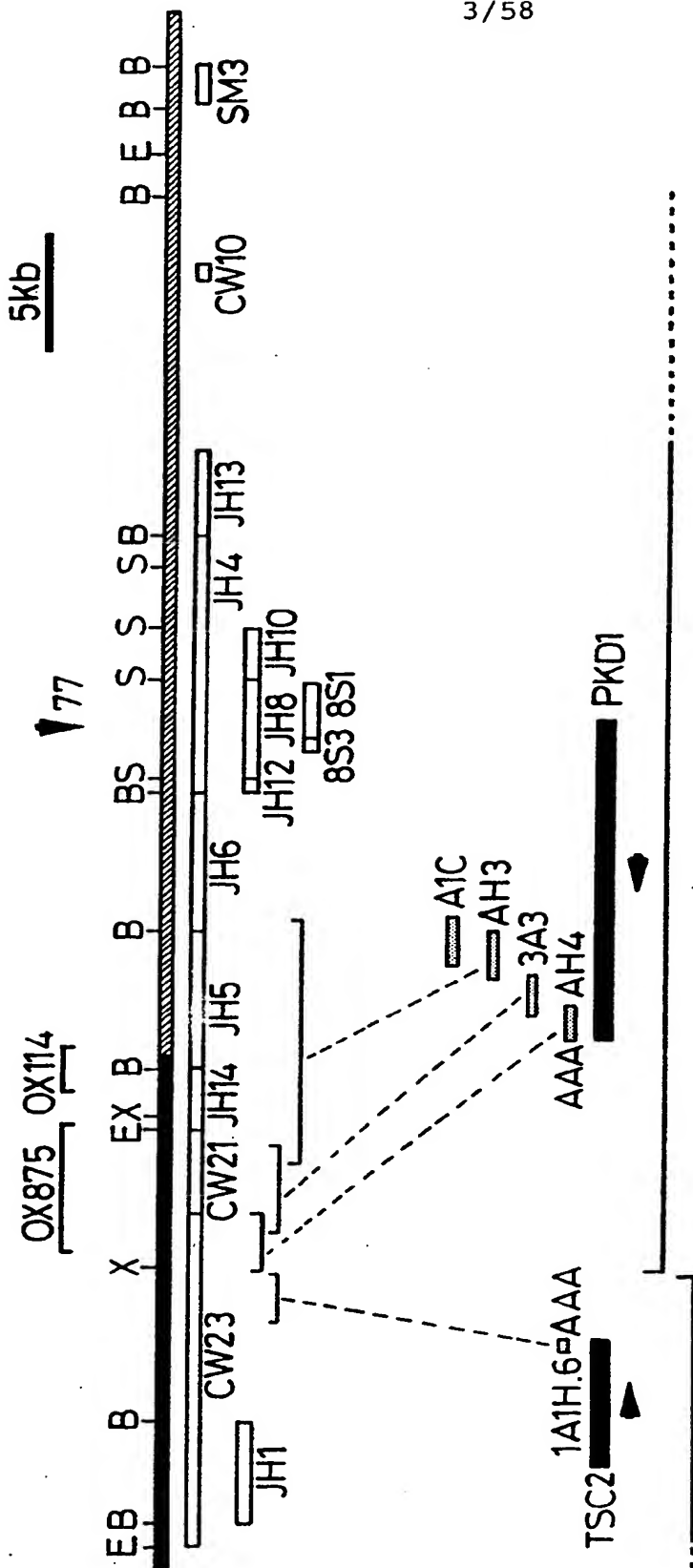


Fig. 3a

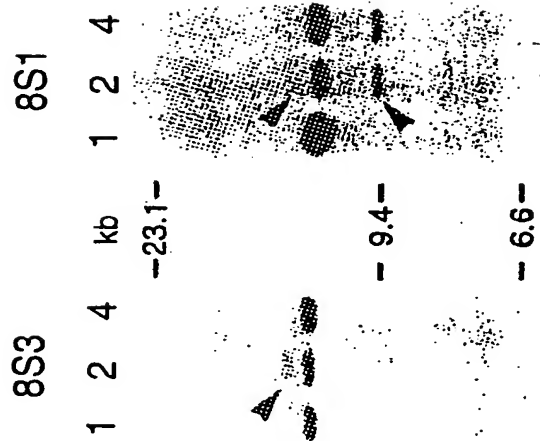


Fig. 3b

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3A3

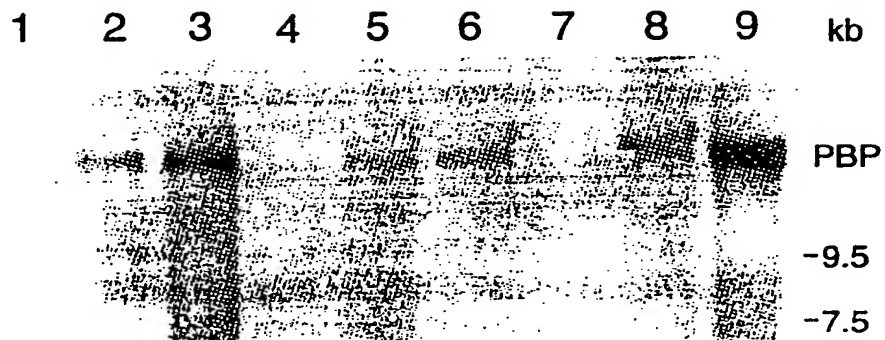


Fig.4a

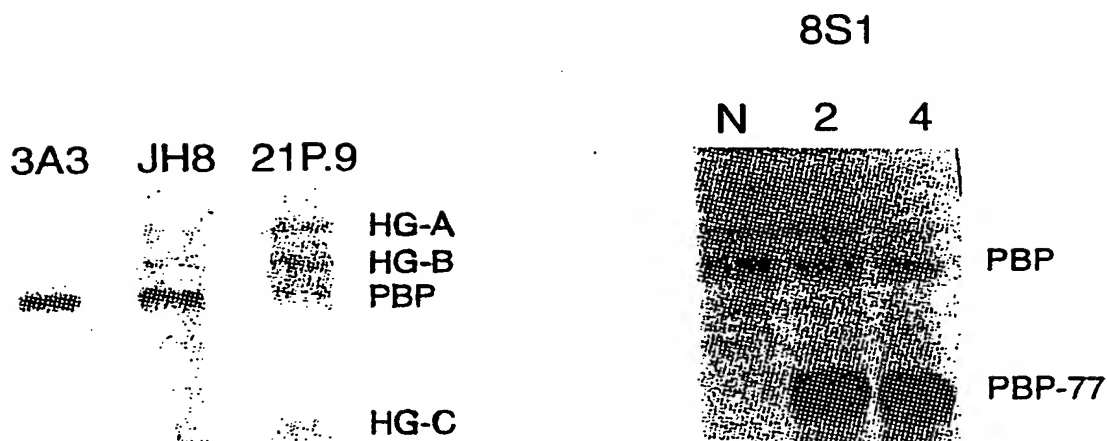


Fig.4b

Fig.4c

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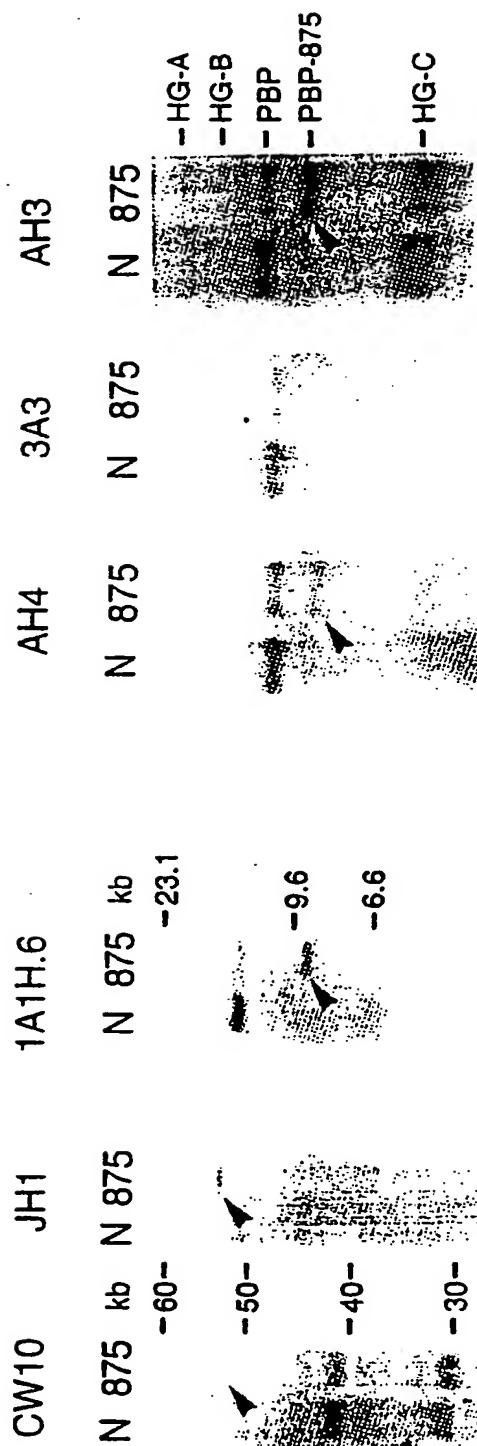


Fig. 5b

Fig. 5a

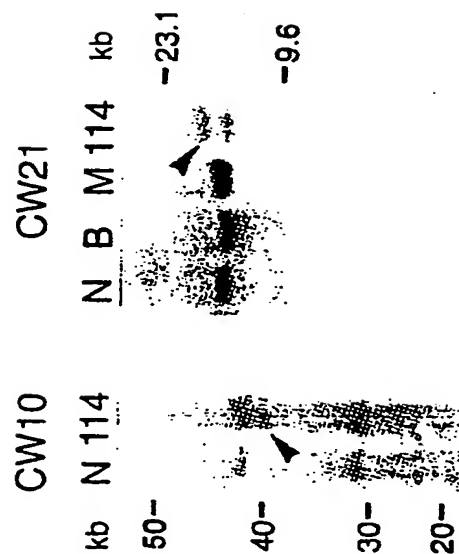


Fig. 5c

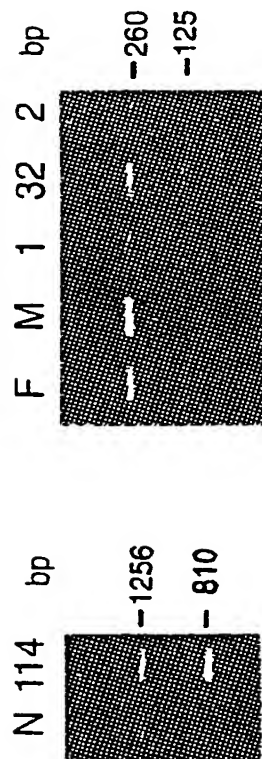


Fig. 5d

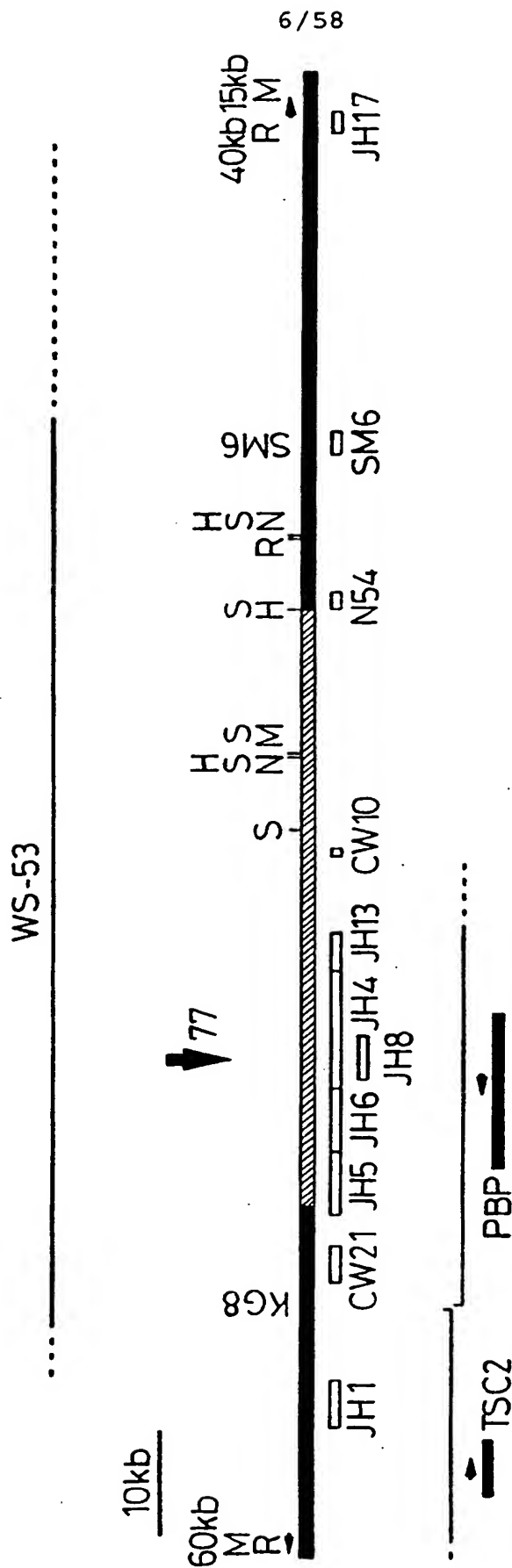


Fig. 6

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1	CTCAACGAGGAGGCGGCTGAAGCTGGGGGGGAGGAGATCGTGGGCGAGGCAAGGCTCG	60
1	L N E E P L T L A G E E I V A Q G K R S	20
61	GACCGGGGAGGCTGCTGTGCTATGGGGGGGCGGCGGCTGGCTGCGACTTCTCATC	120
21	D P R S L L C Y G G A P G P G C H F S I	40
121	CCGAGGCTTTTCAGGGGGGCGGCTGGGCAACCTCAGTGAAGTGGTGCAGCTCATCTTTCTG	180
41	P E A F S G A L A N L S D V V Q L I F L	60
181	GTGGACTOCAATCCCTTTCCCTTTGGCTATATCAGCAACTACAAGTCTCCACCAAGGTG	240
61	V D S N P F P F G Y I S N Y T V S T K V	80
241	GCTCGATGGCATTCCAGACACAGGCGCGCGCGGATCCCATCGAGCGGCTGGGCTCA	300
81	A S M A F Q T Q A G A Q I P I E R L A S	100
301	GAGCGGCGCATCAAGTGAAGGTGCGCAACAACCTGGACTGGGCTGGCGGGGCGACCGC	360
101	E R A I T V K V P N N S D W A A R G H R	120
361	AGCTCGGCAACTCGGCAACTCGGTTGTGGTCCAGCGCGGCGGCTCGGCTGGTGTGTG	420
121	S S A N S A N S V V V V Q P Q A S V G A V	140
421	GTCAACCTGGACAGCAGCAACCTCGGCGCGGGCTGCATCTGCAGCTCAACTATAAGCTG	480
141	V T L D S S N P A A G L H L Q L N Y T L	160
481	CTGGAAGGCGCACTACCTGTCTGAGGAACTGAGCGCTACCTGGCAGTCTACCTACACTCG	540
161	L D G H Y L S E E P E P Y L A V Y L H S	180
541	GAGCGCGGCGCAATGAGCACAACCTGCTCGGCTAGCAGGAGGATCGCGCGAGGTCCTC	600
181	E P R P N E H N C S A S R R I R P E S L	200
601	CAGGTGTCTGAACCGGCGGCTACACCTTCTTCATTTCGCGGGGAGCAGAGCGCGAGG	660
201	Q G A D H R P Y T F F I S P G S R D P A	220
661	GGGAGTTACCATCTGAACCTCTCCAGCACCTTCGCGTGGTGGCGGCTGCAGGTGTGCGTG	720
221	G S Y H L N L S S H F R W S A L Q V S W	240
721	GGCTGTACAGTCCCTGTGCGAGTACTTCAGCGAGGAGGACATGGTGTGGGGACAGAG	780
241	G L Y T S L C Q Y F S E E D M V W R T E	260
781	GGGCTGCTGGCGGCTGGAGGAGAACCTCGCGCGCGCGAGCGCGTCTGCGTCAACCGCGCACTC	840
261	G L L P L E E T S P R Q A V C L T R H L	280
841	ACCGCTTCGGGGCGAGCGCTCTTGTGCGCGCGCAAGCATGTGCGCTTTGTGTCTCTGAG	900
281	T A F G A S L F V P P S H V R F V F P E	300
901	CGACAGCGGATGTAAACTACATGTCATGCTGACATGTGCTGTGTGCGTGGTGAOCTAC	960
301	P T A D V N Y I V M L T C A V C L V T Y	320
961	ATGGTCATGGCGCGCATCTGCGCAAGCTGGAACAGTTGGATGCGAGCGCGCGCGCGCGC	1020
321	M V M A A I L H K L D Q L D A S R G R A	340
1021	ATCCCTTTCTGTGGGCGAGCGGGCGCGCTTCAAGTAAGAGATCTCGTCAAGACAGGCTGG	1080
341	I P F C G Q R G R F K Y E I L V K T G W	360
1081	GGCGGGGCTCAGGTACCAAGCGCGCGCGCTGGGCGATCATGCTGTATGGGTGGACAGCGG	1140
361	G R G S G T T A H V G I M L Y G V D S R	380
1141	AGCGGCGACCGGCACTGGAAGGCGAGAGCGCTTCCACCGCAACAGCTGGACATCTTC	1200
381	S G H R H L D G D R A F H R N S L D I F	400
1201	CGGATCGCGACCGCGCACAGCGTGGGTAGCGTGTGGAAGATCGAGTGTGGCAAGACAAC	1260
401	R I A T P H S L G S V W K I R V W H D N	420

Figure 7

1261 421	AAAGGGCTCAGGCTGCTGGTTGCTGCTGCAAGCAAGTCACTGCTCAGGGAACTGCGAGACGGCA K G L C P A W F L Q H V I V R D L Q T A	1320 440
1321 441	CGCAGGCGCTTCTTTCTGCTGGTCAATGACTGGCTTTTGGGTGGAGACGGAGGCGCAACGGGGGGC R S A F F L V N D W L S V E T E A N G G	1380 460
1381 461	CTGGTGGAGAAAGGAGGTGCTGGGCGGAGGAGCGCAGGCTTTTGGGCTTTCGGGGGCTG L V E K E V L A A S D A A L L R F R R L	140 480
1441 481	CTGGTGGCTGAGCTGCAGGCTGGCTTCTTTGACAAGCACATCTGGCTCTCATATATGGGAC L V A E L Q R G F F D K H I W L S I W D	1500 500
1501 501	CGGGGCGCTGCTAGGCGTTTCACTGCGCATCAGAGGGCGCACTGCTGGGTTCTCTCTCATC R P P R S R F T R I Q R A T C C V L L I	1560 520
1561 521	TGCTCTTCTGCGGGCGCAACGGGCTGTGGTAAGGGGCTGTGTGGGACTCTGCTACAGC C L F L G A N A V W Y G A V G D S A Y S	1620 540
1621 541	ACGGGGCATGTGTGTCAGGCTGAGCGCGCTGAGCGTGCACACAGTGGCTGTGTGGCTGTG T G H V S R L S P L S V D T V A V G L V	1680 560
1681 561	TGCGGCTGGTGTGTCTATCGGCTCTACCTGGGCACTCTTTTCTCTTTCGGATGTTCGGG S S V V V Y P V Y L A I L F L F R M S R	1740 580
1741 581	AGCAAGGTGGCTGGGAGCGCGGAGCGCGGCACTGCGGGGCGAGGCTGCTGGACATGAC S K V A G S P S P T P A G Q Q V L D I D	1800 600
1801 601	AGCTGCTGGACTGTGCTGGTGGTGGACAGCTCTCTCTCTCAGGCTCTCAGGCTCTCAGGCT S C L D S S V L D S S F L T F S G L H A	1860 620
1861 621	GAGGCTTTGTGTGGACAGATGAAGAGTGACTGTGTCTTGGATGATTCTTAAGAGTCTGGTG E A F V G Q M K S D L F L D D S K S L V	1920 640
1921 641	TGCTGGGCGCTCGGGGAGGGAAAGCTCAGTTGGGCGCACTGCTCAGTGAGCGGCTGCAATT C W P S G E G T L S W P D L L S D P S I	1980 660
1981 661	GTGGGTAGCAATCTGCGGCGAGCTGGGCAAGGGGCGCAGGCGGGGCGCATGGGCTGGGCGGAG V G S N L R Q L A R G Q A G H G L G P E	2040 680
2041 681	GAGGACGGCTTCTTCTGCTGGGCGAGCGGCTCTGCTGCGGCTGCGAAATCTTCTCAGCATCAGAT E D G F S L A S P Y S P A K S F S A S D	2100 700
2101 701	GAAGAAGTGTATCAGGAGGTCTTTGCGGAGGGGGTTCAGCAGCGCGCGGCTTACCGAAGAC E D L I Q Q V L A E G V S S P A P T Q D	2160 720
2161 721	AACACATGGAAGCGGAGCTGCTCAGCAGGCTGTGCGGCTCTGCGGAGGAGGAGGAGGAGGAG T H M E T D L L S S L S S T P G E K T E	2220 740
2221 741	AGCTGGGCGCTGCGAGGCTGGGGGAGCTGGGGGCGACCGCGCGGCGGCTGAACTGGGAA T L A L O R L G E L G P P S P G L N W E	2280 760
2281 761	CAGCGCGGCGGAGGCTGTGCGGAGGAGGAGGAGGAGGAGGAGGAGGAGGAGGAGGAGGAGGAG Q P Q A A R L S R T G L V E G L R K R L	2340 780
2341 781	CTGGGCGCTGGTGTGCTGCTGCTGCGGCGAGGCTGAGGCTGCTGCTGCTGCTGCTGCTGCTGCT L P A W C A S L A H G L S L L L V A V A	2400 800
2401 801	GTGGCTGTCTCAGGGTGGGTGGGTGGGAGCTTCCCCCGGGGCTGAGTGTGTGGTGGCTC V A V S G W V G A S F P P G V S V A W L	2460 820
2461 821	CTGTGCGGCGGCGGCGGCTTCTGCGGCTCACTTCTGCGGCTGGGAGCGACTGAAGGTCTTG L S S S A S F L A S F L G W E P L K V L	2520 840

Figure 7 cont'd

2521	CTGGAAGCOCTGTACTTCTCACTGGTGGCCAAGGGCTGCACCOGGATGAAGATGACACC	2580
841	L E A L Y F S L V A K R L H P D E D D T	860
2581	CTGGTAGAGAGCOOOGGCTGTGAAGCOCTGTGAGOGCAOGTGTGCOOOGGTAOOGGOCACOC	2640
861	L V E S P A V T P V S A R V P R V R P P	880
2641	CAOOGCTTTGCACTCTTCTGGCCAAGGAAGAAGCOOOGCAAGGTCAAGAGGCTACATGGC	2700
881	H G F A L F L A K E E A R K V K R L H G	900
2701	ATGCTGOGGAGCOCTCTGGTGTACATGCTTTTTCTGCTGGTGAOOCCTGCTGGOCAGCTAT	2760
901	M L R S L L V Y M L F L L V T L L A S Y	920
2761	GGGATGCOCTCATGOCATGGGCAOGOCTACOGTCTGCAAAGOGOCATCAAGCAGGAGCTG	2820
921	G D A S C H G H A Y R L Q S A I K Q E L	940
2821	CACAGCOOGGCOCTTCTGGOCATCAOOGGCTCTGAGGAGCTCTGGOCATGGATGGOOCAC	2880
941	H S R A F L A I T R S E E L W P W M A H	960
2881	GTGCTGCTGCOOCTAOGTCCAGGGAAOCCAGTCCAGCOOCAGAGCTGGGGGCOOCCACGGCTG	2940
961	V L L P Y V H G N Q S S P E L G P P R L	980
2941	CGGCAGGTGOGGCTGCAGGAAGCACTCTAOCAGAOOCCTCOOOGGCOOC`AGGGTCCACAG	3000
981	R Q V R L Q E A L Y P D P P G P R V H T	1000
3001	TGCTOGGCOOGCAGGAGGCTTCAGCAOCAGOGATTACGACGTTGGCTGGGAGAGTCTCTCAC	3060
1001	C S A A G G F S T S D Y D V G W E S P H	1020
3061	AATGGCTOGGGGAOGTGGGCOCTATTCAOGCOOGGATCTGCTGGGGGCATGGTCTCTGGGGC	3120
1021	N G S G T W A Y S A P D L L G A W S W G	1040
3121	TCTGTGCOOCTGTATGACAGOGGGGGCTAOGTGCAGGAGCTGGGCOCTGAGCOCTGGAGGAG	3180
1041	S C A V Y D S G G Y V Q E L G L S L E E	1060
3181	AGCOOGGACOGGCTGOGCTTCTGTCAGCTGCACAACCTGGCTGGACAACAGGAGCOOGGCT	3240
1061	S R D R L R F L Q L H N W L D N R S R A	1080
3241	GTGTTCTCTGGAGCTCAOOGCTACAGCOOOGGCOOGTGGGGCTGCAOOGCOOOGTCAOOGCTG	3300
1081	V F L E L T R Y S P A V G L H A A V T L	1100
3301	COOCTOGAGTTCOOOGGOGGCOOGGCOOGGCOOCTGGCOOGCOOCTCAGOGTCOOGCOOCTTTGGG	3360
1101	R L E F P A A G R A L A A L S V R P F A	1120
3361	CTGCOOGCOOCTCAGOGOGGGCOCTCTOGCTGCOCTCTGCTCAOCTOGGTGTGCOCTGCTGCTG	3420
1121	L R R L S A G L S L P L L T S V C L L L	1140
3421	TTGCOOGTGCACTTGCOOGTGGCOOGAGGCOOOGTACTTGGCACAGGGAAGGCOGCTGGGOC	3480
1141	F A V H F A V A E A R T W H R E G R W R	1160
3481	GTGCTGOGGCTOGGAGCOCTGGGOGOGGTGGCTGCTGGTGGOGCTGACGGOGGCOCAOGGCA	3540
1161	V L R L G A W A R W L L V A L T A A T A	1180
3541	CTGGTACGOCTOGCOOCAGCTGGGTGCOOGCTGAOOGOCAGTGGACCOOGTTTCGTGCOGGGC	3600
1181	L V R L A Q L G A A D R Q W T R F V R G	1200
3601	COOOGGOGCOOGCTTCACTAGCTTGAOCAGGTGGOGCAOGTGAAGCTCOOGCAGCOOGTGGC	3660
1201	R P R R F T S F D Q V A H V S S A A R G	1220
3661	CTGGOGGCOCTOGCTGCTCTTCTGCTTTTTGGTCAAGGCTGOOCAGCAOGTACCTTTCGTG	3720
1221	L A A S L L F L L L V K A A Q H V R F V	1240
3721	COGCAGTGGTCOOGTCTTTGGCAAGACATTATGOOGAGCTCTGOCAGAGCTCTCTGGGGGTC	3780
1241	R Q W S V F G K T L C R A L P E L L G V	1260

Figure 7 cont'd

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3781	ACCTTGGGCOCTGGTGGTGCTOGGGGTAGCCTACGCOOCAGCTGGOCATCCTGCTCGTGTCT	3840
1261	T L G L V V L G V A Y A Q L A I L L V S	1280
3841	TCCTGTGTGGACTCCTCTGGAGOGTGGCOOCAGGCOCTGTTGGTGTGTGCOOCTGGGACT	3900
1281	S C V D S L W S V A Q A L L V L C P G T	1300
3901	GGGCTCTCTACCOCTGTGTCTGCOGAGTCTGGCAOCTGTCAOCCCTGCTGTGTGTGGGG	3960
1301	G L S T L C P A E S W H L S P L L C V G	1320
3961	CTCTGGGCACTGCGGCTGTGGGGGGOOCTACGGCTGGGGGCTGTTATTTCTOOGCTGGGCG	4020
1321	L W A L R L W G A L R L G A V I L R W R	1340
4021	TACCAOCCCTTGCGTGGAGAGCTGTACCGGCOGGCOCTGGGAGCOOCAGGACTACGAGATG	4080
1341	Y H A L R G E L Y R P A W E P Q D Y E M	1360
4081	GTGGAGTTGTTCTGCGCAGGCTGCGOCTCTGGATGGGCOCTCAGCAAGGTCAAGGAGTTC	4140
1361	V E L F L R R L R L W M G L S K V K E F	1380
4141	CGOCACAAAGTCCGCTTTGAAGGGATGGAGCOGCTGCOOCTCTCGCTCTCTOCAGGGGCTCC	4200
1381	R H K V R F E G M E P L P S R S S R G S	1400
4201	AAGGTATCCCCGGATGTGCCCCCAOCCAGOGCTGGCTOOGATGCOCTGGCAOCCCTOCACC	4260
1401	K V S P D V P P P S A G S D A S H P S T	1420
4261	TCCTOCAGCCAGCTGGATGGGCTGAGOGTGAOCTGGGCOGGCTGGGGACAAGGTGTGAG	4320
1421	S S S Q L D G L S V S L G R L G T R C E	1440
4321	CCTGAGCOOCTCCCGOCTOCAAGCOGTGTTGAGGGOOCTGCTCACCCAGTTTGACCGACTC	4380
1441	P E P S R L Q A V F E A L L T Q F D R L	1460
4381	AAOCAGGOCACAGAGGAOGTCTACOCAGCTGGAGCAGCAGCTGCACAGCOCTGCAAGGCGGC	4440
1461	N Q A T E D V Y Q L E Q Q L H S L Q G R	1480
4441	AGGAGCAGCOGGGGGCOGGGCGGATCTTCCCGTGGCOOCATCCOOGGGCOCTGGCGOCAGCA	4500
1481	R S S R A P A G S S R G P S P G L R P A	1500
4501	CTGCOOCAGCOOCTTGCOOOGGCOAGTCGGGGTGTGGAOCTGGOCCTGGCOOCAGCAGG	4560
1501	L P S R L A R A S R G V D L A T G P S R	1520
4561	ACACCTTGGGGOCAAGAACAAGGTCAOCCOOCAGCAGCACTTAGTCTCTCTTCTGCGGGG	4620
1521	T P S G Q E Q G P P Q Q H L V L L P G G	1540
4621	GGTGGGCOGTGGAGTGGAGTGGACACOGCTCAGTATTACTTTCTGCOGCTGTCAAGGOC	4689
1541	G G P W S R S G H R S V L L S A A V K A	1560
4681	GAGGGOCAGGCAGAAATGGCTGCAOCTAGGTTCCOOCAGAGAGCAGGCAGGGGCATCTGTCT	4740
1561	E G Q A E W L H V G S P E S R Q G H L S	1580
4741	GTCTGTGGGCTTCAGCACTTTAAAGAGGCTGTGTGGOCAOCCAGGACCCAGGGTCCOCTC	4800
1581	V C G L Q H F K E A V W P T R T Q G P L	1600
4801	COOCAGCTCCTTGGGAAGGACACAGCAGTATTGGACGGTTTCTAGCOCTCTGAGATGCTAA	4860
1601	P S S L G K D T A V L D G F	1620
4861	TTTATTTTCCOOGAGTCTCAGGTACAGOGGGCTGTGCOOOGGCOOCACCOOCTGGGCAGAT	4920
4921	GTCCOOCCTGCTAAGGCTGCTGGCTTCAGGGAGGGTTAGCOCTGCAOOGCOGCOACCOCTG	4980
4981	COOCTAAGTTATTACCTCTOCAGTTCTACCOGTACTCOOCTGCAOOGTCTCACTGTGTGTC	5040
5041	TGCTCTCAGTAATTTATATGGTGTAAATGTGTATATTTTTGTATGTCACTATTTTCAC	5100

Figure 7 Cont'd

5101	TAGGGCTGAGGGGCGCTGCGGCCAGAGCTGGGCTCCCCCAACAACCTGCTGCGCTTGGTAGG	5160
5161	TGTGGTGGCGTTATGGCAGCGGCGCTGCTGCTTGGATGCGAGCTTGGGCTTGGGCGGGTG	5220
5221	CTGGGGGGCACAGCTGTCTGOCAGGCACTCTCATCACCCCAGAGGCGCTTGTCACTCCTCCCT	5280
5281	TGCCCCAGGGCAGGTAGCAAGAGAGCAGCGGCCAGGCGCTGCTGGCATCAGGTCTGGGCAA	5340
5341	CTAGCAGGACTAGGCATGTCAGAGGACCCCAGGGTGGTTAGAGGAAAAGACTCCTCCTGG	5400
5401	GGGCTGGCTCCAGGGTGGAGGAAGGTGACTGTGTGTGTGTGTGTGTGCGGCGGGAAGC	5460
5461	GCGACTGTGCTGTATGGGCCAGGCCAGCTCAAGGCGCTCGGAGCTGGCTGTGCGCTGCTTC	5520
5521	TGTGTACCACTTCTGTGGGCATGGGCGCTTCTAGAGCGCTGACACCCCCCAACCCCCGC	5580
5581	AOCAAGCAGACAAAGTCAATAAAAGAGCTGTCTGACTGCAAAAAAAAAAAAAA	5631

1	AAGCTTTGGCA	OCATCAAGGG	OCAGTTCAAC	TTTGTGTCACG	TGATGTCAC	OOOGCTGGAC
61	TACGAGTGA	AOCTGGTGTC	OCTGCAGTGC	AGGAAAGACA	TGGAGGGGCT	TGTGGACAOC
121	AGCGTGGOCA	AGATOGTGTC	TGACGGCAAC	CTGGOOCTTGG	TGGGOGGOGCA	GATGGGOGCTG
181	CAOGCAAAATA	TGGGCTCACA	GGTGCAATCAT	AGGCGCTTCA	AOOOACAOGGA	TATCTAOGCC
241	TOCAAGTGA	TTGGGOGGGCT	OOOGCACATC	AAGOGGCTOC	GOCAGGGGAT	CTGCGAGGAA
301	GOOGGCTACT	CCAAOOOOCAG	OCTAOCCTCTG	GTCACOOCTC	OGTOOCATAG	CAAAGGOGGCT
361	GCACAGACTC	CAGGOGAGOC	CACAOCTGGC	TATGAGGTGG	GOCAGGGGAA	GOGGCTCATC
421	TOCTGGGTGG	AGGACTTCAC	OGAGTTTGTG	TGAGGOGGGG	GOGGCTOOCTC	CTGCACTGGC
481	CTTGGAGGGT	ATTGOGCTGTC	AGTGAAATAA	ATAAAGTCT	GACOOOCAGTG	CACAGACATA
541	GAGGACACAGA	TTTGC				

1	GTCGGGGGTC	GCAAGTACGC	TTCTGGTGTG	TGTGAGACGT	GGGGGGCTGG	GAAGTGTTGG
61	CAGACGGGGA	GTAAGTCTCT	ACTCTTTTTC	TTCTTTTGAC	CTAAGCTGGC	GAGTGGCACT
121	GCTGAGTTTC	GCTCAGTGCC	CGCCCTGATG	TGCGACCCCC	GTGCA.TTCTT	GCTGTTAGGT
181	GGTGGGGGTG	TG				

1 AGGCAGGTCT OOOOACGAG CAGGGGAGAG GCACCCAGG T

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(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 1: (Compare Fig.1)

C GGC GGC GGC TGC CGC GTC AAC TGC TGC GGC CGC GGG CTG CCG ACG	46
Gly Ala Ala Cys Arg Val Asn Cys Ser Gly Arg Gly Leu Arg Thr	
1 5 10 15	
CTC GGT OGC GCG CTG CGC ATC CCC GCG GAC GGC ACA GCG CTA GAC GTC	94
Leu Gly Pro Ala Leu Arg Ile Pro Ala Asp Ala Thr Ala Leu Asp Val	
20 25 30	
TOC CAC AAC CTG CTC CGG GCG CTG GAC GTT GGG CTC CTG GCG AAC CTC	142
Ser His Asn Leu Leu Arg Ala Leu Asp Val Gly Leu Leu Ala Asn Leu	
35 40 45	
TOG GCG CTG GCA GAG CTG GAT ATA AGC AAC AAC AAG ATT TCT ACG TTA	190
Ser Ala Leu Ala Glu Leu Asp Ile Ser Asn Asn Lys Ile Ser Thr Leu	
50 55 60	
GAA GAA GGA ATA TTT GCT AAT TTA TTT AAT TTA AGT GAA ATA AAC CTG	238
Glu Glu Gly Ile Phe Ala Asn Leu Phe Asn Leu Ser Glu Ile Asn Leu	
65 70 75	
AGT GGG AAC CCG TTT GAG TGT GAC TGT GGC CTG GCG TGG CTG CCG CGA	286
Ser Gly Asn Pro Phe Glu Cys Asp Cys Gly Leu Ala Trp Leu Pro Arg	
80 85 90 95	
TGG GCG GAG GAG CAG CAG GTG CCG GTG GTG CAG CCG GAG GCA GGC ACG	334
Trp Ala Glu Glu Gln Gln Val Arg Val Val Gln Pro Glu Ala Ala Thr	
100 105 110	
TGT GCT GGG OCT GGC TOC CTG GCT GGC CAG OCT CTG CTT GGC ATC CCG	382
Cys Ala Gly Pro Gly Ser Leu Ala Gly Gln Pro Leu Leu Gly Ile Pro	
115 120 125	
TTG CTG GAC AGT GGC TGT GGT GAG GAG TAT GTC GGC TGC CTC OCT GAC	430
Leu Leu Asp Ser Gly Cys Gly Glu Glu Tyr Val Ala Cys Leu Pro Asp	
130 135 140	
AAC AGC TCA GGC ACC GTG GCA GCA GTG TOC TTT TCA GCT GGC CAC GAA	478
Asn Ser Ser Gly Thr Val Ala Ala Val Ser Phe Ser Ala Ala His Glu	
145 150 155	
GGC CTG CTT CAG CCA GAG GGC TGC AGC GGC TTC TGC TTC TOC ACC GGC	526
Gly Leu Leu Gln Pro Glu Ala Cys Ser Ala Phe Cys Phe Ser Thr Gly	
160 165 170 175	
CAG GGC CTC GCA GGC CTC TCG GAG CAG GGC TGG TGC CTG TGT GGG GCG	574
Gln Gly Leu Ala Ala Leu Ser Glu Gln Gly Trp Cys Leu Cys Gly Ala	
180 185 190	
GCC CAG CCC TOC AGT GGC TOC TTT GGC TGC CTG TOC CTC TGC TOC GGC	622
Ala Gln Pro Ser Ser Ala Ser Phe Ala Cys Leu Ser Leu Cys Ser Gly	
195 200 205	
CCC CCG CCA CCT CCT GGC CCC ACC TGT AGG GGC CCC ACC CTC CTC CAG	670
Pro Pro Pro Pro Pro Ala Pro Thr Cys Arg Gly Pro Thr Leu Leu Gln	
210 215 220	
CAC GTC TTC CCT GGC TOC CCA GGG GGC ACC CTG GTG GGG CCC CAC GGA	718
His Val Phe Pro Ala Ser Pro Gly Ala Thr Leu Val Gly Pro His Gly	
225 230 235	

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OCT CTG GOC TCT GGC CAG CTA GCA GOC TTC CAC ATC GCT GOC OCG CTC Pro Leu Ala Ser Gly Gln Leu Ala Ala Phe His Ile Ala Ala Pro Leu 240 245 250 255	766
OCT GTC ACT GOC ACA OGC TGG GAC TTC GGA GAC GGC TOC GOC GAG GTG Pro Val Thr Ala Thr Arg Trp Asp Phe Gly Asp Gly Ser Ala Glu Val 260 265 270	814
GAT GOC GCT GGG OCG GCT GOC TOG CAT OGC TAT GTG CTG OCT GGG OGC Asp Ala Ala Gly Pro Ala Ala Ser His Arg Tyr Val Leu Pro Gly Arg 275 280 285	862
TAT CAC GTG ACG GOC GTG CTG GOC CTG GGG GOC GGC TCA GOC CTG CTG Tyr His Val Thr Ala Val Leu Ala Leu Gly Ala Gly Ser Ala Leu Leu 290 295 300	910
GGG ACA GAC GTG CAG GTG GAA GOG GCA OCT GOC GOC CTG GAG CTC GTG Gly Thr Asp Val Gln Val Glu Ala Ala Pro Ala Ala Leu Glu Leu Val 305 310 315	958
TGC OCG TOC TOG GTG CAG AGT GAC GAG AGC CTT GAC CTC AGC ATC CAG Cys Pro Ser Ser Val Gln Ser Asp Glu Ser Leu Asp Leu Ser Ile Gln 320 325 330 335	1006
AAC OGC GGT GGT TCA GGC CTG GAG GOC GOC TAC AGC ATC GTG GOC CTG Asn Arg Gly Gly Ser Gly Leu Glu Ala Ala Tyr Ser Ile Val Ala Leu 340 345 350	1054
GGC GAG GAG OCG GOC OGA GOG GTG CAC OCG CTC TGC CCC TOG GAC ACG Gly Glu Glu Pro Ala Arg Ala Val His Pro Leu Cys Pro Ser Asp Thr 355 360 365	1102
GAG ATC TTC OCT GGC AAC GGG CAC TGC TAC OCG CTG GTG GTG GAG AAG Glu Ile Phe Pro Gly Asn Gly His Cys Tyr Arg Leu Val Val Glu Lys 370 375 380	1150
GOG GOC TGG CTG CAG GOG CAG GAG CAG TGT CAG GOC TGG GOC GGG GOC Ala Ala Trp Leu Gln Ala Gln Glu Gln Cys Gln Ala Trp Ala Gly Ala 385 390 395	1198
GOC CTG GCA ATG GTG GAC AGT OCG GOC GTG CAG OCG TTC CTG GTC TOC Ala Leu Ala Met Val Asp Ser Pro Ala Val Gln Arg Phe Leu Val Ser 400 405 410 415	1246
CGG GTC ACC AGG AGC CTA GAC GTG TGG ATC GGC TTC TOG ACT GTG CAG Arg Val Thr Arg Ser Leu Asp Val Trp Ile Gly Phe Ser Thr Val Gln 420 425 430	1294
GGG GTG GAG GTG GGC CCA GOG OCG CAG GGC GAG GOC TTC AGC CTG GAG Gly Val Glu Val Gly Pro Ala Pro Gln Gly Glu Ala Phe Ser Leu Glu 435 440 445	1342
AGC TGC CAG AAC TGG CTG CCC GGG GAG OCA CAC OCA GOC ACA GOC GAG Ser Cys Gln Asn Trp Leu Pro Gly Glu Pro His Pro Ala Thr Ala Glu 450 455 460	1390
CAC TGC GTC OGG CTC GGG OCG ACC GGG TGG TGT AAC ACC GAC CTG TGC His Cys Val Arg Leu Gly Pro Thr Gly Trp Cys Asn Thr Asp Leu Cys 465 470 475	1438

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TCA GCG CCG CAC AGC TAC GTC TGC GAG CTG CAG CCG GGA GGC CCA GTG Ser Ala Pro His Ser Tyr Val Cys Glu Leu Gln Pro Gly Gly Pro Val 480 485 490 495	1486
CAG GAT GGC GAG AAC CTC CTC GTG GGA GCG CCG AGT GGG GAC CTG CAG Gln Asp Ala Glu Asn Leu Leu Val Gly Ala Pro Ser Gly Asp Leu Gln 500 505 510	1534
GGA CCG CTG ACG OCT CTC GCA CAG CAG GAC GGC CTC TCA GGC CCG CAC Gly Pro Leu Thr Pro Leu Ala Gln Gln Asp Gly Leu Ser Ala Pro His 515 520 525	1582
GAG CCG GTG GAG GTC ATG GTA TTC CCG GGC CTG CGT CTG AGC CGT GAA Glu Pro Val Glu Val Met Val Phe Pro Gly Leu Arg Leu Ser Arg Glu 530 535 540	1630
GCC TTC CTC ACC ACG GGC GAA TTT GGG ACC CAG GAG CTC CGG CGG CCG Ala Phe Leu Thr Thr Ala Gln Phe Gly Thr Gln Glu Leu Arg Arg Pro 545 550 555	1678
GCC CAG CTG CGG CTG CAG GTG TAC CCG CTC CTC AGC ACA GCA GGG ACC Ala Gln Leu Arg Leu Gln Val Tyr Arg Leu Leu Ser Thr Ala Gly Thr 560 565 570 575	1726
CCG GAG AAC GGC AGC GAG OCT GAG AGC AGG TCC CCG GAC AAC AGG ACC Pro Glu Asn Gly Ser Glu Pro Glu Ser Arg Ser Pro Asp Asn Arg Thr 580 585 590	1774
CAG CTG GGC CCG GCG TGC ATG CCA GGG GGA CCG TGG TGC OCT GGA GGC Gln Leu Ala Pro Ala Cys Met Pro Gly Gly Arg Trp Cys Pro Gly Ala 595 600 605	1822
AAC ATC TGC TTG CCG CTG GAC GGC TCT TGC CAC CCG CAG GGC TGC GGC Asn Ile Cys Leu Pro Leu Asp Ala Ser Cys His Pro Gln Ala Cys Ala 610 615 620	1870
AAT GGC TGC ACG TCA GGG CCA GGG CTA CCG GGG GGC CCG TAT GCG CTA Asn Gly Cys Thr Ser Gly Pro Gly Leu Pro Gly Ala Pro Tyr Ala Leu 625 630 635	1918
TGG AGA GAG TTC CTC TTC TCC GTT GGC GCG GGG CCG CCG GCG CAG TAC Trp Arg Glu Phe Leu Phe Ser Val Ala Ala Gly Pro Pro Ala Gln Tyr 640 645 650 655	1966
TOG GTC ACC CTC CAC GGC CAG GAT GTC CTC ATG CTC OCT GGT GAC CTC Ser Val Thr Leu His Gly Gln Asp Val Leu Met Leu Pro Gly Asp Leu 660 665 670	2014
GTT GGC TTG CAG CAC GAC GCT GGC OCT GGC GGC CTC CTG CAC TGC TCG Val Gly Leu Gln His Asp Ala Gly Pro Gly Ala Leu Leu His Cys Ser 675 680 685	2062
CCG GCT CCG GGC CAC OCT GGT CCG CAG GGC CCG TAC CTC TCC GGC AAC Pro Ala Pro Gly His Pro Gly Pro Gln Ala Pro Tyr Leu Ser Ala Asn 690 695 700	2110
GCC TCG TCA TGG CTG CCG CAC TTG CCA GGC CAG CTG GAG GGC ACT TGG Ala Ser Ser Trp Leu Pro His Leu Pro Ala Gln Leu Glu Gly Thr Trp 705 710 715	2158

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GOC TGC OCT GOC TGT GOC CTG CCG CTG CTT GCA GOC ACG GAA CAG CTC Ala Cys Pro Ala Cys Ala Leu Arg Leu Leu Ala Ala Thr Glu Gln Leu 720 725 730 735	2206
AOC GTG CTG CTG GGC TTG AGG CCG AAC OCT GGA CTG CCG ATG OCT GGG Thr Val Leu Leu Gly Leu Arg Pro Asn Pro Gly Leu Arg Met Pro Gly 740 745 750	2254
CGC TAT GAG GTC CCG GCA GAG GTG GGC AAT GGC GTG TOC AGG CAC AAC Arg Tyr Glu Val Arg Ala Glu Val Gly Asn Gly Val Ser Arg His Asn 755 760 765	2302
CTC TOC TGC AGC TTT GAC GTG GTC TOC CCA GTG GCT GGG CTG CCG GTC Leu Ser Cys Ser Phe Asp Val Val Ser Pro Val Ala Gly Leu Arg Val 770 775 780	2350
ATC TAC OCT GOC CCG CCG GAC GGC CCG CTC TAC GTG CCG AOC AAC GGC Ile Tyr Pro Ala Pro Arg Asp Gly Arg Leu Tyr Val Pro Thr Asn Gly 785 790 795	2398
TCA GOC TTG GTG CTC CAG GTG GAC TCT GGT GOC AAC GOC ACG GOC ACG Ser Ala Leu Val Leu Gln Val Asp Ser Gly Ala Asn Ala Thr Ala Thr 800 805 810 815	2446
GCT CCG TGG OCT GGG GGC AGT GTC AGC GOC CCG TTT GAG AAT GTC TGC Ala Arg Trp Pro Gly Gly Ser Val Ser Ala Arg Phe Glu Asn Val Cys 820 825 830	2494
OCT GOC CTG GTG GOC AOC TTC GTG CCG GGC TGC CCG TGG GAG AOC AAC Pro Ala Leu Val Ala Thr Phe Val Pro Gly Cys Pro Trp Glu Thr Asn 835 840 845	2542
GAT AOC CTG TTC TCA GTG GTA GCA CTG CCG TGG CTC AGT GAG GGC GAG Asp Thr Leu Phe Ser Val Val Ala Leu Pro Trp Leu Ser Glu Gly Glu 850 855 860	2590
CAC GTG GTG GAC GTG GTG GTG GAA AAC AGC GOC AGC CCG GOC AAC CTC His Val Val Asp Val Val Val Glu Asn Ser Ala Ser Arg Ala Asn Leu 865 870 875	2638
AGC CTG CCG GTG ACG GCG GAG GAG CCG ATC TGT GGC CTC CCG GOC ACG Ser Leu Arg Val Thr Ala Glu Glu Pro Ile Cys Gly Leu Arg Ala Thr 880 885 890 895	2686
CCG AGC CCG GAG GOC CGT GTA CTG CAG GGA GTC CTA GTG AGG TAC AGC Pro Ser Pro Glu Ala Arg Val Leu Gln Gly Val Leu Val Arg Tyr Ser 900 905 910	2734
CCG GTG GTG GAG GOC GGC TOG GAC ATG GTC TTC CCG TGG AOC ATC AAC Pro Val Val Glu Ala Gly Ser Asp Met Val Phe Arg Trp Thr Ile Asn 915 920 925	2782
GAC AAG CAG TOC CTG AOC TTC CAG AAC GTG GTC TTC AAT GTC ATT TAT Asp Lys Gln Ser Leu Thr Phe Gln Asn Val Val Phe Asn Val Ile Tyr 930 935 940	2830
CAG AGC GCG GCG GTC TTC AAG CTC TCA CTG ACG GOC TOC AAC CAC GTG Gln Ser Ala Ala Val Phe Lys Leu Ser Leu Thr Ala Ser Asn His Val 945 950 955	2878

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AGC AAC GTC ACC GTG AAC TAC AAC GTA ACC GTG GAG OGG ATG AAC AGG Ser Asn Val Thr Val Asn Tyr Asn Val Thr Val Glu Arg Met Asn Arg 960 965 970 975	2926
ATG CAG GGT CTG CAG GTC TOC ACA GTG CCG GOC GTG CTG TOC CCC AAT Met Gln Gly Leu Gln Val Ser Thr Val Pro Ala Val Leu Ser Pro Asn 980 985 990	2974
GCC ACA CTG GTA CTG ACG GGT GGT GTG CTG GTG GAC TCA GCT GTG GAG Ala Thr Leu Val Leu Thr Gly Gly Val Leu Val Asp Ser Ala Val Glu 995 1000 1005	3022
GTG GOC TTC CTG TGG AAC TTT GGG GAT GGG GAG CAG GOC CTC CAC CAG Val Ala Phe Leu Trp Asn Phe Gly Asp Gly Glu Gln Ala Leu His Gln 1010 1015 1020	3070
TTC CAG OCT CCG TAC AAC GAG TOC TTC CCG GTT OCA GAC CCC TOG GTG Phe Gln Pro Pro Tyr Asn Glu Ser Phe Pro Val Pro Asp Pro Ser Val 1025 1030 1035	3118
GCC CAG GTG CTG GTG GAG CAC AAT GTC ATG CAC ACC TAC GCT GCC OCA Ala Gln Val Leu Val Glu His Asn Val Met His Thr Tyr Ala Ala Pro 1040 1045 1050 1055	3166
GGT GAG TAC CTC CTG ACC GTG CTG GCA TCT AAT GOC TTC GAG AAC CTG Gly Glu Tyr Leu Leu Thr Val Leu Ala Ser Asn Ala Phe Glu Asn Leu 1060 1065 1070	3214
ACG CAG CAG GTG OCT GTG AGC GTG CCG GOC TOC CTG CCC TOC GTG GCT Thr Gln Gln Val Pro Val Ser Val Arg Ala Ser Leu Pro Ser Val Ala 1075 1080 1085	3262
GTG GGT GTG AGT GAC GGC GTC CTG GTG GOC GGC CCG CCC GTC ACC TTC Val Gly Val Ser Asp Gly Val Leu Val Ala Gly Arg Pro Val Thr Phe 1090 1095 1100	3310
TAC CCG CAC CCG CTG CCC TOG OCT GGG GGT GTT CTT TAC ACG TGG GAC Tyr Pro His Pro Leu Pro Ser Pro Gly Gly Val Leu Tyr Thr Trp Asp 1105 1110 1115	3358
TTC GGG GAC GGC TOC OCT GTC CTG ACC CAG AGC CAG CCG GCT GCC AAC Phe Gly Asp Gly Ser Pro Val Leu Thr Gln Ser Gln Pro Ala Ala Asn 1120 1125 1130 1135	3406
CAC ACC TAT GOC TOG AGG GGC ACC TAC CAC GTG CCG CTG GAG GTC AAC His Thr Tyr Ala Ser Arg Gly Thr Tyr His Val Arg Leu Glu Val Asn 1140 1145 1150	3454
AAC ACG GTG AGC GGT GCG GCG GOC CAG GCG GAT GTG CCG GTC TTT GAG Asn Thr Val Ser Gly Ala Ala Ala Gln Ala Asp Val Arg Val Phe Glu 1155 1160 1165	3502
GAG CTC CCG GGA CTC AGC GTG GAC ATG AGC CTG GOC GTG GAG CAG GGC Glu Leu Arg Gly Leu Ser Val Asp Met Ser Leu Ala Val Glu Gln Gly 1170 1175 1180	3550
GCC CCC GTG GTG GTC AGC GCG GCG GTG CAG ACG GGC GAC AAC ATC ACG Ala Pro Val Val Val Ser Ala Ala Val Gln Thr Gly Asp Asn Ile Thr 1185 1190 1195	3598

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TGG ACC TTC GAC ATG GGG GAC GGC ACC GTG CTG TCG GGC CCG GAG GCA Trp Thr Phe Asp Met Gly Asp Gly Thr Val Leu Ser Gly Pro Glu Ala 1200 1205 1210 1215	3646
ACA GTG GAG CAT GTG TAC CTG CCG GCA CAG AAC TGC ACA GTG ACC GTG Thr Val Glu His Val Tyr Leu Arg Ala Gln Asn Cys Thr Val Thr Val 1220 1225 1230	3694
GGT GCG GGC AGC CCC GGC GGC CAC CTG GGC CCG AGC CTG CAC GTG CTG Gly Ala Ala Ser Pro Ala Gly His Leu Ala Arg Ser Leu His Val Leu 1235 1240 1245	3742
GTC TTC GTC CTG GAG GTG CTG CCG GTT GAA CCC GGC GGC TGC ATC CCC Val Phe Val Leu Glu Val Leu Arg Val Glu Pro Ala Ala Cys Ile Pro 1250 1255 1260	3790
ACG CAG OCT GAC GCG CCG CTC ACG GGC TAC GTC ACC GCG AAC CCG GGC Thr Gln Pro Asp Ala Arg Leu Thr Ala Tyr Val Thr Gly Asn Pro Ala 1265 1270 1275	3838
CAC TAC CTC TTC GAC TGG ACC TTC GGG GAT GGC TCC TCC AAC ACG ACC His Tyr Leu Phe Asp Trp Thr Phe Gly Asp Gly Ser Ser Asn Thr Thr 1280 1285 1290 1295	3886
GTG CCG GGG TGC CCG ACG GTG ACA CAC AAC TTC ACG CCG AGC GGC ACG Val Arg Gly Cys Pro Thr Val Thr His Asn Phe Thr Arg Ser Gly Thr 1300 1305 1310	3934
TTC CCC CTG GCG CTG GTG CTG TCC AGC CCG GTG AAC AGG GCG CAT TAC Phe Pro Leu Ala Leu Val Leu Ser Ser Arg Val Asn Arg Ala His Tyr 1315 1320 1325	3982
TTC ACC AGC ATC TGC GTG GAG CCA GAG GTG GGC AAC GTC ACC CTG CAG Phe Thr Ser Ile Cys Val Glu Pro Glu Val Gly Asn Val Thr Leu Gln 1330 1335 1340	4030
CCA GAG AGG CAG TTT GTG CAG CTC GGG GAC GAG GGC TGG CTG GTG GCA Pro Glu Arg Gln Phe Val Gln Leu Gly Asp Glu Ala Trp Leu Val Ala 1345 1350 1355	4078
TGT GGC TGG CCC CCG TTC CCC TAC CCG TAC ACC TGG GAC TTT GGC ACC Cys Ala Trp Pro Pro Phe Pro Tyr Arg Tyr Thr Trp Asp Phe Gly Thr 1360 1365 1370 1375	4126
GAG GAA GGC GGC CCC ACC CGT GGC AGG GGC CCT GAG GTG ACG TTC ATC Glu Glu Ala Ala Pro Thr Arg Ala Arg Gly Pro Glu Val Thr Phe Ile 1380 1385 1390	4174
TAC CGA GAC CCA GGC TCC TAT CTT GTG ACA GTC ACC GCG TCC AAC AAC Tyr Arg Asp Pro Gly Ser Tyr Leu Val Thr Val Thr Ala Ser Asn Asn 1395 1400 1405	4222
ATC TCT GCT GGC AAT GAC TCA GGC CTG GTG GAG GTG CAG GAG CCC GTG Ile Ser Ala Ala Asn Asp Ser Ala Leu Val Glu Val Gln Glu Pro Val 1410 1415 1420	4270
CTG GTC ACC AGC ATC AAG GTC AAT GGC TCC CTT GGG CTG GAG CTG CAG Leu Val Thr Ser Ile Lys Val Asn Gly Ser Leu Gly Leu Glu Leu Gln 1425 1430 1435	4318

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CAG CCG TAC CTG TTC TCT GCT GTG GGC CGT GGG OGC OCC GOC AGC TAC Gln Pro Tyr Leu Phe Ser Ala Val Gly Arg Gly Arg Pro Ala Ser Tyr 1440 1445 1450 1455	4366
CTG TGG GAT CTG GGG GAC GGT GGG TGG CTC GAG GGT OCG GAG GTC ACC Leu Trp Asp Leu Gly Asp Gly Gly Trp Leu Glu Gly Pro Glu Val Thr 1460 1465 1470	4414
CAC GCT TAC AAC AGC ACA GGT GAC TTC ACC GTT AGG GTG GOC GGC TGG His Ala Tyr Asn Ser Thr Gly Asp Phe Thr Val Arg Val Ala Gly Trp 1475 1480 1485	4462
AAT GAG GTG AGC OGC AGC GAG GOC TGG CTC AAT GTG ACG GTG AAG CCG Asn Glu Val Ser Arg Ser Glu Ala Trp Leu Asn Val Thr Val Lys Arg 1490 1495 1500	4510
CGC GTG OGC GGG CTC GTC GTC AAT GCA AGC OGC ACG GTG GTG OCC CTG Arg Val Arg Gly Leu Val Val Asn Ala Ser Arg Thr Val Val Pro Leu 1505 1510 1515	4558
AAT GGG AGC GTG AGC TTC AGC ACG TOG CTG GAG GOC GGC AGT GAT GTG Asn Gly Ser Val Ser Phe Ser Thr Ser Leu Glu Ala Gly Ser Asp Val 1520 1525 1530 1535	4606
CGC TAT TOC TGG GTG CTC TGT GAC OGC TGC ACG OCC ATC OCT GGG GGT Arg Tyr Ser Trp Val Leu Cys Asp Arg Cys Thr Pro Ile Pro Gly Gly 1540 1545 1550	4654
OCT ACC ATC TCT TAC ACC TTC OGC TOC GTG GGC ACC TTC AAT ATC ATC Pro Thr Ile Ser Tyr Thr Phe Arg Ser Val Gly Thr Phe Asn Ile Ile 1555 1560 1565	4702
GTC ACG GCT GAG AAC GAG GTG GGC TOC GOC CAG GAC AGC ATC TTC GTC Val Thr Ala Glu Asn Glu Val Gly Ser Ala Gln Asp Ser Ile Phe Val 1570 1575 1580	4750
TAT GTC CTG CAG CTC ATA GAG GGG CTG CAG GTG GTG GGC GGT GGC OGC Tyr Val Leu Gln Leu Ile Glu Gly Leu Gln Val Val Gly Gly Gly Arg 1585 1590 1595	4798
TAC TTC OCC ACC AAC CAC ACG GTA CAG CTG CAG GOC GTG GTT AGG GAT Tyr Phe Pro Thr Asn His Thr Val Gln Leu Gln Ala Val Val Arg Asp 1600 1605 1610 1615	4846
GGC ACC AAC GTC TOC TAC AGC TGG ACT GOC TGG AGG GAC AGG GGC CCG Gly Thr Asn Val Ser Tyr Ser Trp Thr Ala Trp Arg Asp Arg Gly Pro 1620 1625 1630	4894
GOC CTG GOC GGC AGC GGC AAA GGC TTC TOG CTC AOC GTG CTC GAG GOC Ala Leu Ala Gly Ser Gly Lys Gly Phe Ser Leu Thr Val Leu Glu Ala 1635 1640 1645	4942
GGC ACC TAC CAT GTG CAG CTG CCG GOC AOC AAC ATG CTG GGC AGC GOC Gly Thr Tyr His Val Gln Leu Arg Ala Thr Asn Met Leu Gly Ser Ala 1650 1655 1660	4990
TGG GOC GAC TGC ACC ATG GAC TTC GTG GAG OCT GTG GGG TGG CTG ATG Trp Ala Asp Cys Thr Met Asp Phe Val Glu Pro Val Gly Trp Leu Met 1665 1670 1675	5038

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GTG ACC GOC TOC CCG AAC CCA GCT GOC GTC AAC ACA AGC GTC ACC CTC Val Thr Ala Ser Pro Asn Pro Ala Ala Val Asn Thr Ser Val Thr Leu 1680 1685 1690 1695	5086
AGT GOC GAG CTG GCT GGT GGC AGT GGT GTC GTA TAC ACT TGG TOC TTG Ser Ala Glu Leu Ala Gly Gly Ser Gly Val Val Tyr Thr Trp Ser Leu 1700 1705 1710	5134
GAG GAG GGG CTG AGC TGG GAG AOC TOC GAG CCA TTT ACC ACC CAT AGC Glu Glu Gly Leu Ser Trp Glu Thr Ser Glu Pro Phe Thr Thr His Ser 1715 1720 1725	5182
TTC CCG ACA CCG GGC CTG CAC TTG GTC ACC ATG ACG GCA GGG AAC CCG Phe Pro Thr Pro Gly Leu His Leu Val Thr Met Thr Ala Gly Asn Pro 1730 1735 1740	5230
CTG GGC TCA GOC AAC GOC AOC GTG GAA GTG GAT GTG CAG GTG OCT GTG Leu Gly Ser Ala Asn Ala Thr Val Glu Val Asp Val Gln Val Pro Val 1745 1750 1755	5278
AGT GGC CTC AGC ATC AGG GOC AGC GAG CCG GGA GGC AGC TTC GTG GCG Ser Gly Leu Ser Ile Arg Ala Ser Glu Pro Gly Gly Ser Phe Val Ala 1760 1765 1770 1775	5326
GOC GGG TOC TCT GTG CCG TTT TGG GGG CAG CTG GOC ACG GGC ACC AAT Ala Gly Ser Ser Val Pro Phe Trp Gly Gln Leu Ala Thr Gly Thr Asn 1780 1785 1790	5374
GTG AGC TGG TGC TGG GCT GTG CCG GGC GGC AGC AGC AAG CGT GGC OCT Val Ser Trp Cys Trp Ala Val Pro Gly Gly Ser Ser Lys Arg Gly Pro 1795 1800 1805	5422
CAT GTC ACC ATG GTC TTC CCG GAT GCT GGC AOC TTC TOC ATC CCG CTC His Val Thr Met Val Phe Pro Asp Ala Gly Thr Phe Ser Ile Arg Leu 1810 1815 1820	5470
AAT GOC TOC AAC GCA GTC AGC TGG GTC TCA GOC ACG TAC AAC CTC ACG Asn Ala Ser Asn Ala Val Ser Trp Val Ser Ala Thr Tyr Asn Leu Thr 1825 1830 1835	5518
GCG GAG GAG CCG ATC GTG GGC CTG GTG CTG TGG GOC AGC AGC AAG GTG Ala Glu Glu Pro Ile Val Gly Leu Val Leu Trp Ala Ser Ser Lys Val 1840 1845 1850 1855	5566
GTG GCG CCG GGG CAG CTG GTC CAT TTT CAG ATC CTG CTG GCT GOC GGC Val Ala Pro Gly Gln Leu Val His Phe Gln Ile Leu Leu Ala Ala Gly 1860 1865 1870	5614
TCA GCT GTC AOC TTC CCG CTG CAG GTC GGC GGG GOC AAC CCG GAG GTG Ser Ala Val Thr Phe Arg Leu Gln Val Gly Gly Ala Asn Pro Glu Val 1875 1880 1885	5662
CTC CCG GGG CCG CGT TTC TOC CAC AGC TTC CCG CCG GTC GGA GAC CAC Leu Pro Gly Pro Arg Phe Ser His Ser Phe Pro Arg Val Gly Asp His 1890 1895 1900	5710
GTG GTG AGC GTG CCG GGC AAA AAC CAC GTG AGC TGG GOC CAG GCG CAG Val Val Ser Val Arg Gly Lys Asn His Val Ser Trp Ala Gln Ala Gln 1905 1910 1915	5758

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GTG GGC ATC GTG GTG CTG GAG GGC GTG AGT GGG CTG CAG ATG CCC AAC Val Arg Ile Val Val Leu Glu Ala Val Ser Gly Leu Gln Met Pro Asn 1920 1925 1930 1935	5806
TGC TGC GAG OCT GGC ATC GGC ACG GGC ACT GAG AGG AAC TTC ACA GGC Cys Cys Glu Pro Gly Ile Ala Thr Gly Thr Glu Arg Asn Phe Thr Ala 1940 1945 1950	5854
CGC GTG CAG CGC GGC TCT CCG GTC GGC TAC GGC TGG TAC TTC TCG CTG Arg Val Gln Arg Gly Ser Arg Val Ala Tyr Ala Trp Tyr Phe Ser Leu 1955 1960 1965	5902
CAG AAG GTC CAG GGC GAC TCG CTG GTC ATC CTG TCG GGC CGC GAC GTC Gln Lys Val Gln Gly Asp Ser Leu Val Ile Leu Ser Gly Arg Asp Val 1970 1975 1980	5950
AAC TAC ACG CCC GTG GGC GCG GGG CTG TTG GAG ATC CAG GTG CGC GGC Thr Tyr Thr Pro Val Ala Ala Gly Leu Leu Glu Ile Gln Val Arg Ala 1985 1990 1995	5998
TTC AAC GGC CTG GGC AGT GAG AAC CGC ACG CTG GTG CTG GAG GTT CAG Phe Asn Ala Leu Gly Ser Glu Asn Arg Thr Leu Val Leu Glu Val Gln 2000 2005 2010 2015	6046
GAC GGC GTC CAG TAT GTG GGC CTG CAG AGC GGC CCC TGC TTC AAC AAC Asp Ala Val Gln Tyr Val Ala Leu Gln Ser Gly Pro Cys Phe Thr Asn 2020 2025 2030	6094
CGC TCG GCG CAG TTT GAG GGC GGC ACC AGC CCC AGC CCC CGG CGT GTG Arg Ser Ala Gln Phe Glu Ala Ala Thr Ser Pro Ser Pro Arg Arg Val 2035 2040 2045	6142
GCC TAC CAC TGG GAC TTT GGG GAT GGG TCG CCA GGG CAG GAC ACA GAT Ala Tyr His Trp Asp Phe Gly Asp Gly Ser Pro Gly Gln Asp Thr Asp 2050 2055 2060	6190
GAG CCC AGG GGC GAG CAC TCC TAC CTG AGG CCT GGG GAC TAC CGC GTG Glu Pro Arg Ala Glu His Ser Tyr Leu Arg Pro Gly Asp Tyr Arg Val 2065 2070 2075	6238
CAG GTG AAC GGC TCC AAC CTG GTG AGC TTC TTC GTG GCG CAG GGC ACG Gln Val Asn Ala Ser Asn Leu Val Ser Phe Phe Val Ala Gln Ala Thr 2080 2085 2090 2095	6286
GTG ACC GTC CAG GTG CTG GGC TGC CGG GAG CCG GAG GTG GAC GTG GTC Val Thr Val Gln Val Leu Ala Cys Arg Glu Pro Glu Val Asp Val Val 2100 2105 2110	6334
CTG CCC CTG CAG GTG CTG ATG CGG CGA TCA CAG CGC AAC TAC TTG GAG Leu Pro Leu Gln Val Leu Met Arg Arg Ser Gln Arg Asn Tyr Leu Glu 2115 2120 2125	6382
GCC CAC GTT GAC CTG CGC GAC TGC GTC ACC TAC CAG ACT GAG TAC CGC Ala His Val Asp Leu Arg Asp Cys Val Thr Tyr Gln Thr Glu Tyr Arg 2130 2135 2140	6430
TGG GAG GTG TAT CGC ACC GGC AGC TGC CAG CGG CCG GGG CGC CCA GCG Trp Glu Val Tyr Arg Thr Ala Ser Cys Gln Arg Pro Gly Arg Pro Ala 2145 2150 2155	6478

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OGT GTG GOC CTG OOC GGC GTG GAC GTG AGC OGG OCT OGG CTG GTG CTG Arg Val Ala Leu Pro Gly Val Asp Val Ser Arg Pro Arg Leu Val Leu 2160 2165 2170 2175	6526
COG OGG CTG GOG CTG OCT GTG GGG CAC TAC TGC TTT GTG TTT GTC GTG Pro Arg Leu Ala Leu Pro Val Gly His Tyr Cys Phe Val Phe Val Val 2180 2185 2190	6574
TCA TTT GGG GAC ACG OCA CTG ACA CAG AGC ATC CAG GOC AAT GTG ACG Ser Phe Gly Asp Thr Pro Leu Thr Gln Ser Ile Gln Ala Asn Val Thr 2195 2200 2205	6622
GTG GOC OOC GAG OGC CTG GTG OOC ATC ATT GAG GGT GGC TCA TAC OGC Val Ala Pro Glu Arg Leu Val Pro Ile Ile Glu Gly Gly Ser Tyr Arg 2210 2215 2220	6670
GTG TGG TCA GAC ACA OGG GAC CTG GTG CTG GAT GGG AGC GAG TOC TAC Val Trp Ser Asp Thr Arg Asp Leu Val Leu Asp Gly Ser Glu Ser Tyr 2225 2230 2235	6718
GAC OOC AAC CTG GAG GAC GGC GAC CAG ACG OCG CTC AGT TTC CAC TGG Asp Pro Asn Leu Glu Asp Gly Asp Gln Thr Pro Leu Ser Phe His Trp 2240 2245 2250 2255	6766
GOC TGT GTG GCT TOG ACA CAG AGG GAG GCT GGC GGG TGT GCG CTG AAC Ala Cys Val Ala Ser Thr Gln Arg Glu Ala Gly Gly Cys Ala Leu Asn 2260 2265 2270	6814
TTT GGG OOC OGC GGG AGC AGC ACG GTC ACC ATT OCA OGG GAG OGG CTG Phe Gly Pro Arg Gly Ser Ser Thr Val Thr Ile Pro Arg Glu Arg Leu 2275 2280 2285	6862
GCG GCT GGC GTG GAG TAC ACC TTC AGC CTG ACC GTG TGG AAG GOC GGC Ala Ala Gly Val Glu Tyr Thr Phe Ser Leu Thr Val Trp Lys Ala Gly 2290 2295 2300	6910
OGC AAG GAG GAG GOC AOC AAC CAG ACG GTG CTG ATC OGG AGT GGC OGG Arg Lys Glu Glu Ala Thr Asn Gln Thr Val Leu Ile Arg Ser Gly Arg 2305 2310 2315	6958
GTG OOC ATT GTG TOC TTG GAG TGT GTG TOC TGC AAG GCA CAG GOC GTG Val Pro Ile Val Ser Leu Glu Cys Val Ser Cys Lys Ala Gln Ala Val 2320 2325 2330 2335	7006
TAC GAA GTG AGC OGC AGC TOC TAC GTG TAC TTG GAG GGC OGC TGC CTC Tyr Glu Val Ser Arg Ser Ser Tyr Val Tyr Leu Glu Gly Arg Cys Leu 2340 2345 2350	7054
AAT TGC AGC AGC GGC TOC AAG OGA GGG OGG TGG GCT GCA OGT ACG TTC Asn Cys Ser Ser Gly Ser Lys Arg Gly Arg Trp Ala Ala Arg Thr Phe 2355 2360 2365	7102
AGC AAC AAG ACG CTG GTG CTG GAT GAG AOC AOC ACA TOC ACG GGC AGT Ser Asn Lys Thr Leu Val Leu Asp Glu Thr Thr Thr Ser Thr Gly Ser 2370 2375 2380	7150
GCA GGC ATG OGA CTG GTG CTG OGG OGG GGC GTG CTG OGG GAC GGC GAG Ala Gly Met Arg Leu Val Leu Arg Arg Gly Val Leu Arg Asp Gly Glu 2385 2390 2395	7198

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GGA TAC ACC TTC ACG CTC ACG GTG CTG GGC OGC TCT GGC GAG GAG GAG Gly Tyr Thr Phe Thr Leu Thr Val Leu Gly Arg Ser Gly Glu Glu Glu 2400 2405 2410 2415	7246
GGC TGC GGC TOC ATC OGC CTG TOC OOC AAC OGC OOG OOG CTG GGC GGC Gly Cys Ala Ser Ile Arg Leu Ser Pro Asn Arg Pro Pro Leu Gly Gly 2420 2425 2430	7294
TCT TGC OGC CTC TTC CCA CTG GGC GCT GTG CAC GOC CTC AOC AOC AAG Ser Cys Arg Leu Phe Pro Leu Gly Ala Val His Ala Leu Thr Thr Lys 2435 2440 2445	7342
GTG CAC TTC GAA TGC ACG GGC TGG CAT GAC GOG GAG GAT GCT GGC GOC Val His Phe Glu Cys Thr Gly Trp His Asp Ala Glu Asp Ala Gly Ala 2450 2455 2460	7390
COG CTG GTG TAC GOC CTG CTG CTG OGG OGC TGT OGC CAG GGC CAC TGC Pro Leu Val Tyr Ala Leu Leu Leu Arg Arg Cys Arg Gln Gly His Cys 2465 2470 2475	7438
GAG GAG TTC TGT GTC TAC AAG GGC AGC CTC TOC AGC TAC GGA GOC GTG Glu Glu Phe Cys Val Tyr Lys Gly Ser Leu Ser Ser Tyr Gly Ala Val 2480 2485 2490 2495	7486
CTG OOC OOG GGT TTC AGG CCA CAC TTC GAG GTG GGC CTG GOC GTG GTG Leu Pro Pro Gly Phe Arg Pro His Phe Glu Val Gly Leu Ala Val Val 2500 2505 2510	7534
GTG CAG GAC CAG CTG GGA GOC GCT GTG GTC GOC CTC AAC AGG TCT TTG Val Gln Asp Gln Leu Gly Ala Ala Val Val Ala Leu Asn Arg Ser Leu 2515 2520 2525	7582
GOC ATC AOC CTC CCA GAG OOC AAC GGC AGC GCA AOC GGG CTC ACA GTC Ala Ile Thr Leu Pro Glu Pro Asn Gly Ser Ala Thr Gly Leu Thr Val 2530 2535 2540	7630
TGG CTG CAC GGG CTC AOC GCT AGT GTG CTC CCA GGG CTG CTG OGG CAG Trp Leu His Gly Leu Thr Ala Ser Val Leu Pro Gly Leu Leu Arg Gln 2545 2550 2555	7678
GOC GAT OOC CAG CAC GTC ATC GAG TAC TOG TTG GOC CTG GTC AOC GTG Ala Asp Pro Gln His Val Ile Glu Tyr Ser Leu Ala Leu Val Thr Val 2560 2565 2570 2575	7726
CTG AAC GAG TAC GAG OGG GOC CTG GAC GTG GOG GCA GAG OOC AAG CAC Leu Asn Glu Tyr Glu Arg Ala Leu Asp Val Ala Ala Glu Pro Lys His 2580 2585 2590	7774
GAG OGG CAG CAC CCA GOC CAG ATA OGC AAG AAC ATC AOC GAG ACT CTG Glu Arg Gln His Arg Ala Gln Ile Arg Lys Asn Ile Thr Glu Thr Leu 2595 2600 2605	7822
GTG TOC CTG AGG GTC CAC ACT GTG GAT GAC ATC CAG CAG ATC GCT GCT Val Ser Leu Arg Val His Thr Val Asp Asp Ile Gln Gln Ile Ala Ala 2610 2615 2620	7870
GOG CTG GOC CAG TGC ATG GGG OOC AGC AGG GAG CTC GTA TGC OGC TOG Ala Leu Ala Gln Cys Met Gly Pro Ser Arg Glu Leu Val Cys Arg Ser 2625 2630 2635	7918

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TGC CTG AAG CAG ACG CTG CAC AAG CTG GAG GGC ATG ATG CTC ATC CTG Cys Leu Lys Gln Thr Leu His Lys Leu Glu Ala Met Met Leu Ile Leu 2640 2645 2650 2655	7966
CAG GCA GAG AOC ACC GOG GGC AOC GTG AOG COC AOC GOC ATC GGA GAC Gln Ala Glu Thr Thr Ala Gly Thr Val Thr Pro Thr Ala Ile Gly Asp 2660 2665 2670	8014
AGC ATC CTC AAC ATC ACA GGA GAC CTC ATC CAC CTG GOC AGC TOG GAC Ser Ile Leu Asn Ile Thr Gly Asp Leu Ile His Leu Ala Ser Ser Asp 2675 2680 2685	8062
GTG OGG GCA OCA CAG COC TCA GAG CTG GGA GOC GAG TCA OCA TCT OGG Val Arg Ala Pro Gln Pro Ser Glu Leu Gly Ala Glu Ser Pro Ser Arg 2690 2695 2700	8110
ATG GTG GOG TOC CAG GOC TAC AAC CTG AOC TCT GOC CTC ATG OGC ATC Met Val Ala Ser Gln Ala Tyr Asn Leu Thr Ser Ala Leu Met Arg Ile 2705 2710 2715	8158
CTC ATG OGC TOC OGC GTG CTC AAC GAG GAG COC CTG AOG CTG GOG GGC Leu Met Arg Ser Arg Val Leu Asn Glu Glu Pro Leu Thr Leu Ala Gly 2720 2725 2730 2735	8206
GAG GAG ATC GTG GOC CAG GGC AAG OGC TOG GAC COG OGG AGC CTG CTG Glu Glu Ile Val Ala Gln Gly Lys Arg Ser Asp Pro Arg Ser Leu Leu 2740 2745 2750	8254
TGC TAT GGC GGC GOC OCA GGG OCT GGC TGC CAC TTC TOC ATC OOC GAG Cys Tyr Gly Gly Ala Pro Gly Pro Gly Cys His Phe Ser Ile Pro Glu 2755 2760 2765	8302
GCT TTC AGC GGG GOC CTG GOC AAC CTC AGT GAC GTG GTG CAG CTC ATC Ala Phe Ser Gly Ala Leu Ala Asn Leu Ser Asp Val Val Gln Leu Ile 2770 2775 2780	8350
TTT CTG GTG GAC TOC AAT OOC TTT OOC TTT GGC TAT ATC AGC AAC TAC Phe Leu Val Asp Ser Asn Pro Phe Pro Phe Gly Tyr Ile Ser Asn Tyr 2785 2790 2795	8398
AOC GTC TOC AOC AAG GTG GOC TOG ATG GCA TTC CAG ACA CAG GOC GGC Thr Val Ser Thr Lys Val Ala Ser Met Ala Phe Gln Thr Gln Ala Gly 2800 2805 2810 2815	8446
GOC CAG ATC COC ATC GAG OGG CTG GOC TCA GAG OGC GOC ATC AOC GTG Ala Gln Ile Pro Ile Glu Arg Leu Ala Ser Glu Arg Ala Ile Thr Val 2820 2825 2830	8494
AAG GTG COC AAC AAC TOG GAC TGG GCT GOC OGG GGC CAC OGC AGC TOC Lys Val Pro Asn Asn Ser Asp Trp Ala Ala Arg Gly His Arg Ser Ser 2835 2840 2845	8542
GOC AAC TOC GOC AAC TOC GTT GTG GTC CAG COC CAG GOC TOC GTC GGT Ala Asn Ser Ala Asn Ser Val Val Val Gln Pro Gln Ala Ser Val Gly 2850 2855 2860	8590
GCT GTG GTC AOC CTG GAC AGC AGC AAC OCT GOG GOC GGG CTG CAT CTG Ala Val Val Thr Leu Asp Ser Ser Asn Pro Ala Ala Gly Leu His Leu 2865 2870 2875	8638

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CAG CTC AAC TAT ACG CTG CTG GAC GGC CAC TAC CTG TCT GAG GAA OCT Gln Leu Asn Tyr Thr Leu Leu Asp Gly His Tyr Leu Ser Glu Glu Pro 2880 2885 2890 2895	8686
GAG CCC TAC CTG GCA GTC TAC CTA CAC TOG GAG CCC CGG CCC AAT GAG Glu Pro Tyr Leu Ala Val Tyr Leu His Ser Glu Pro Arg Pro Asn Glu 2900 2905 2910	8734
CAC AAC TGC TOG GCT AGC AGG AGG ATC CGC OCA GAG TCA CTC CAG GGT His Asn Cys Ser Ala Ser Arg Arg Ile Arg Pro Glu Ser Leu Gln Gly 2915 2920 2925	8782
GCT GAC CAC CGG CCC TAC ACC TTC TTC ATT TOC CCG GGG AGC AGA GAC Ala Asp His Arg Pro Tyr Thr Phe Phe Ile Ser Pro Gly Ser Arg Asp 2930 2935 2940	8830
OCA GCG GGG AGT TAC CAT CTG AAC CTC TOC AGC CAC TTC CGC TGG TOG Pro Ala Gly Ser Tyr His Leu Asn Leu Ser Ser His Phe Arg Trp Ser 2945 2950 2955	8878
GCG CTG CAG GTG TOC GTG GGC CTG TAC ACG TOC CTG TGC CAG TAC TTC Ala Leu Gln Val Ser Val Gly Leu Tyr Thr Ser Leu Cys Gln Tyr Phe 2960 2965 2970 2975	8926
AGC GAG GAG GAC ATG GTG TGG CGG ACA GAG GGG CTG CTG CCC CTG GAG Ser Glu Glu Asp Met Val Trp Arg Thr Glu Gly Leu Leu Pro Leu Glu 2980 2985 2990	8974
GAG ACC TOG CCC CGC CAG GGC GTC TGC CTC ACC CGC CAC CTC ACC GGC Glu Thr Ser Pro Arg Gln Ala Val Cys Leu Thr Arg His Leu Thr Ala 2995 3000 3005	9022
TTC GGC GGC AGC CTC TTC GTG CCC OCA AGC CAT GTC CGC TTT GTG TTT Phe Gly Ala Ser Leu Phe Val Pro Pro Ser His Val Arg Phe Val Phe 3010 3015 3020	9070
OCT GAG CCG ACA GCG GAT GTA AAC TAC ATC GTC ATG CTG ACA TGT GCT Pro Glu Pro Thr Ala Asp Val Asn Tyr Ile Val Met Leu Thr Cys Ala 3025 3030 3035	9118
GTG TGC CTG GTG ACC TAC ATG GTC ATG GGC GGC ATC CTG CAC AAG CTG Val Cys Leu Val Thr Tyr Met Val Met Ala Ala Ile Leu His Lys Leu 3040 3045 3050 3055	9166
GAC CAG TTG GAT GCC AGC CGG GGC CGC GGC ATC OCT TTC TGT GGG CAG Asp Gln Leu Asp Ala Ser Arg Gly Arg Ala Ile Pro Phe Cys Gly Gln 3060 3065 3070	9214
CGG GGC CGC TTC AAG TAC GAG ATC CTC GTC AAG ACA GGC TGG GGC CGG Arg Gly Arg Phe Lys Tyr Glu Ile Leu Val Lys Thr Gly Trp Gly Arg 3075 3080 3085	9262
GGC TCA GGT ACC ACG GGC CAC GTG GGC ATC ATG CTG TAT GGG GTG GAC Gly Ser Gly Thr Thr Ala His Val Gly Ile Met Leu Tyr Gly Val Asp 3090 3095 3100	9310
AGC CGG AGC GGC CAC CGG CAC CTG GAC GGC GAC AGA GGC TTC CAC CGC Ser Arg Ser Gly His Arg His Leu Asp Gly Asp Arg Ala Phe His Arg 3105 3110 3115	9358

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AAC AGC CTG GAC ATC TTC OGG ATC GGC ACC OCG CAC AGC CTG GGT AGC Asn Ser Leu Asp Ile Phe Arg Ile Ala Thr Pro His Ser Leu Gly Ser 3120 3125 3130 3135	9406
GTG TGG AAG ATC OGA GTG TGG CAC GAC AAC AAA GGG CTC AGC OCT GGC Val Trp Lys Ile Arg Val Trp His Asp Asn Lys Gly Leu Ser Pro Ala 3140 3145 3150	9454
TGG TTC CTG CAG CAC GTC ATC GTC AGG GAC CTG CAG ACG GCA GGC AGC Trp Phe Leu Gln His Val Ile Val Arg Asp Leu Gln Thr Ala Arg Ser 3155 3160 3165	9502
GCC TTC TTC CTG GTC AAT GAC TGG CTT TCG GTG GAG ACG GAG GGC AAC Ala Phe Phe Leu Val Asn Asp Trp Leu Ser Val Glu Thr Glu Ala Asn 3170 3175 3180	9550
GGG GGC CTG GTG GAG AAG GAG GTG CTG GGC GCG AGC GAC GCA GGC CTT Gly Gly Leu Val Glu Lys Glu Val Leu Ala Ala Ser Asp Ala Ala Leu 3185 3190 3195	9598
TTG CGC TTC OGG GGC CTG CTG GTG GCT GAG CTG CAG CGT GGC TTC TTT Leu Arg Phe Arg Arg Leu Leu Val Ala Glu Leu Gln Arg Gly Phe Phe 3200 3205 3210 3215	9646
GAC AAG CAC ATC TGG CTC TOC ATA TGG GAC OGG OCG OCT CGT AGC CGT Asp Lys His Ile Trp Leu Ser Ile Trp Asp Arg Pro Pro Arg Ser Arg 3220 3225 3230	9694
TTC ACT CGC ATC CAG AGG GGC AOC TGC TGC GTT CTC CTC ATC TGC CTC Phe Thr Arg Ile Gln Arg Ala Thr Cys Cys Val Leu Leu Ile Cys Leu 3235 3240 3245	9742
TTC CTG GGC GGC AAC GGC GTG TGG TAC GGG GCT GTT GGC GAC TCT GGC Phe Leu Gly Ala Asn Ala Val Trp Tyr Gly Ala Val Gly Asp Ser Ala 3250 3255 3260	9790
TAC AGC ACG GGG CAT GTG TOC AGG CTG AGC OCG CTG AGC GTC GAC ACA Tyr Ser Thr Gly His Val Ser Arg Leu Ser Pro Leu Ser Val Asp Thr 3265 3270 3275	9838
GTC GCT GTT GGC CTG GTG TOC AGC GTG GTT GTC TAT CCC GTC TAC CTG Val Ala Val Gly Leu Val Ser Ser Val Val Val Tyr Pro Val Tyr Leu 3280 3285 3290 3295	9886
GCC ATC CTT TTT CTC TTC OGG ATG TOC OGG AGC AAG GTG GCT GGG AGC Ala Ile Leu Phe Leu Phe Arg Met Ser Arg Ser Lys Val Ala Gly Ser 3300 3305 3310	9934
CCG AGC CCC ACA OCT GGC GGG CAG CAG GTG CTG GAC ATC GAC AGC TGC Pro Ser Pro Thr Pro Ala Gly Gln Gln Val Leu Asp Ile Asp Ser Cys 3315 3320 3325	9982
CTG GAC TCG TOC GTG CTG GAC AGC TOC TTC CTC ACG TTC TCA GGC CTC Leu Asp Ser Ser Val Leu Asp Ser Ser Phe Leu Thr Phe Ser Gly Leu 3330 3335 3340	10030
CAC GCT GAG GGC TTT GTT GGA CAG ATG AAG AGT GAC TTG TTT CTG GAT His Ala Glu Ala Phe Val Gly Gln Met Lys Ser Asp Leu Phe Leu Asp 3345 3350 3355	10078

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GAT TCT AAG AGT CTG GTG TGC TGG CCC TOC GGC GAG GGA ACG CTC AGT Asp Ser Lys Ser Leu Val Cys Trp Pro Ser Gly Glu Gly Thr Leu Ser 3360 3365 3370 3375	10126
TGG CCG GAC CTG CTC AGT GAC CCG TOC ATT GTG GGT AGC AAT CTG CCG Trp Pro Asp Leu Leu Ser Asp Pro Ser Ile Val Gly Ser Asn Leu Arg 3380 3385 3390	10174
CAG CTG GCA CCG GGC CAG GCG GGC CAT GGG CTG GGC CCA GAG GAG GAC Gln Leu Ala Arg Gly Gln Ala Gly His Gly Leu Gly Pro Glu Glu Asp 3395 3400 3405	10222
GGC TTC TOC CTG GOC AGC CCG TAC TOG OCT GOC AAA TOC TTC TCA GCA Gly Phe Ser Leu Ala Ser Pro Tyr Ser Pro Ala Lys Ser Phe Ser Ala 3410 3415 3420	10270
TCA GAT GAA GAC CTG ATC CAG CAG GTC CTT GOC GAG GGG GTC AGC AGC Ser Asp Glu Asp Leu Ile Gln Gln Val Leu Ala Glu Gly Val Ser Ser 3425 3430 3435	10318
CCA GOC OCT ACC CAA GAC ACC CAC ATG GAA ACG GAC CTG CTC AGC AGC Pro Ala Pro Thr Gln Asp Thr His Met Glu Thr Asp Leu Leu Ser Ser 3440 3445 3450 3455	10366
CTG TOC AGC ACT OCT GGG GAG AAG ACA GAG ACG CTG GCG CTG CAG AGG Leu Ser Ser Thr Pro Gly Glu Lys Thr Glu Thr Leu Ala Leu Gln Arg 3460 3465 3470	10414
CTG GGG GAG CTG GGG CCA CCG AGC CCA GGC CTG AAC TGG GAA CAG CCG Leu Gly Glu Leu Gly Pro Pro Ser Pro Gly Leu Asn Trp Glu Gln Pro 3475 3480 3485	10462
CAG GCA GCG AGG CTG TOC AGG ACA GGA CTG GTG GAG GGT CTG CCG AAG Gln Ala Ala Arg Leu Ser Arg Thr Gly Leu Val Glu Gly Leu Arg Lys 3490 3495 3500	10510
CGC CTG CTG CCG GOC TGG TGT GOC TOC CTG GOC CAC GGG CTC AGC CTG Arg Leu Leu Pro Ala Trp Cys Ala Ser Leu Ala His Gly Leu Ser Leu 3505 3510 3515	10558
CTC CTG GTG GCT GTG GCT GTG GCT GTC TCA GGG TGG GTG GGT GCG AGC Leu Leu Val Ala Val Ala Val Ala Val Ser Gly Trp Val Gly Ala Ser 3520 3525 3530 3535	10606
TTC CCG CCG GGC GTG AGT GTT GCG TGG CTC CTG TOC AGC AGC GOC AGC Phe Pro Pro Gly Val Ser Val Ala Trp Leu Leu Ser Ser Ser Ala Ser 3540 3545 3550	10654
TTC CTG GOC TCA TTC CTC GGC TGG GAG CCA CTG AAG GTC TTG CTG GAA Phe Leu Ala Ser Phe Leu Gly Trp Glu Pro Leu Lys Val Leu Leu Glu 3555 3560 3565	10702
GOC CTG TAC TTC TCA CTG GTG GOC AAG CCG CTG CAC CCG GAT GAA GAT Ala Leu Tyr Phe Ser Leu Val Ala Lys Arg Leu His Pro Asp Glu Asp 3570 3575 3580	10750
GAC ACC CTG GTA GAG AGC CCG GCT GTG ACG OCT GTG AGC GCA CGT GTG Asp Thr Leu Val Glu Ser Pro Ala Val Thr Pro Val Ser Ala Arg Val 3585 3590 3595	10798

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<p> OCC OGC GTA OGG OCA CCC CAC GGC TTT GCA CTC TTC CTG GOC AAG GAA Pro Arg Val Arg Pro Pro His Gly Phe Ala Leu Phe Leu Ala Lys Glu 3600 3605 3610 3615 </p>	10846
<p> GAA GOC OGC AAG GTC AAG AGG CTA CAT GGC ATG CTG OGG AGC CTC CTG Glu Ala Arg Lys Val Lys Arg Leu His Gly Met Leu Arg Ser Leu Leu 3620 3625 3630 </p>	10894
<p> GTG TAC ATG CTT TTT CTG CTG GTG ACC CTG CTG GOC AGC TAT GGG GAT Val Tyr Met Leu Phe Leu Leu Val Thr Leu Leu Ala Ser Tyr Gly Asp 3635 3640 3645 </p>	10942
<p> GOC TCA TGC CAT GGG CAC GOC TAC OGT CTG CAA AGC GOC ATC AAG CAG Ala Ser Cys His Gly His Ala Tyr Arg Leu Gln Ser Ala Ile Lys Gln 3650 3655 3660 </p>	10990
<p> GAG CTG CAC AGC OGG GOC TTC CTG GOC ATC ACG OGG TCT GAG GAG CTC Glu Leu His Ser Arg Ala Phe Leu Ala Ile Thr Arg Ser Glu Glu Leu 3665 3670 3675 </p>	11038
<p> TGG OCA TGG ATG GOC CAC GTG CTG CTG OCC TAC GTC CAC GGG AAC CAG Trp Pro Trp Met Ala His Val Leu Leu Pro Tyr Val His Gly Asn Gln 3680 3685 3690 3695 </p>	11086
<p> TOC AGC OCA GAG CTG GGG OCC OCA OGG CTG OGG CAG GTG OGG CTG CAG Ser Ser Pro Glu Leu Gly Pro Pro Arg Leu Arg Gln Val Arg Leu Gln 3700 3705 3710 </p>	11134
<p> GAA GCA CTC TAC OCA GAC OCT OCC GGC OCC AGG GTC CAC ACG TGC TOG Glu Ala Leu Tyr Pro Asp Pro Pro Gly Pro Arg Val His Thr Cys Ser 3715 3720 3725 </p>	11182
<p> GOC GCA GGA GGC TTC AGC AOC AGC GAT TAC GAC GTT GGC TGG GAG AGT Ala Ala Gly Gly Phe Ser Thr Ser Asp Tyr Asp Val Gly Trp Glu Ser 3730 3735 3740 </p>	11230
<p> OCT CAC AAT GGC TOG GGG ACG TGG GOC TAT TCA GOG OCG GAT CTG CTG Pro His Asn Gly Ser Gly Thr Trp Ala Tyr Ser Ala Pro Asp Leu Leu 3745 3750 3755 </p>	11278
<p> GGG GCA TGG TOC TGG GGC TOC TGT GOC GTG TAT GAC AGC GGG GGC TAC Gly Ala Trp Ser Trp Gly Ser Cys Ala Val Tyr Asp Ser Gly Gly Tyr 3760 3765 3770 3775 </p>	11326
<p> GTG CAG GAG CTG GGC CTG AGC CTG GAG GAG AGC OGC GAC OGG CTG OGC Val Gln Glu Leu Gly Leu Ser Leu Glu Glu Ser Arg Asp Arg Leu Arg 3780 3785 3790 </p>	11374
<p> TTC CTG CAG CTG CAC AAC TGG CTG GAC AAC AGG AGC OGC GCT GTG TTC Phe Leu Gln Leu His Asn Trp Leu Asp Asn Arg Ser Arg Ala Val Phe 3795 3800 3805 </p>	11422
<p> CTG GAG CTC ACG OGC TAC AGC OCG GOC GTG GGG CTG CAC GOC GOC GTC Leu Glu Leu Thr Arg Tyr Ser Pro Ala Val Gly Leu His Ala Ala Val 3810 3815 3820 </p>	11470
<p> ACG CTG OGC CTC GAG TTC OCG GOG GOC GGC OGC GOC CTG GOC GOC CTC Thr Leu Arg Leu Glu Phe Pro Ala Ala Gly Arg Ala Leu Ala Ala Leu 3825 3830 3835 </p>	11518

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AGC	GTC	OGC	CCC	TTT	GCG	CTG	OGC	OGC	CTC	AGC	GCG	GGC	CTC	TOG	CTG	11566
Ser	Val	Arg	Pro	Phe	Ala	Leu	Arg	Arg	Leu	Ser	Ala	Gly	Leu	Ser	Leu	
3840					3845					3850					3855	
OCT	CTG	CTC	ACC	TOG	GTG	TGC	CTG	CTG	CTG	TTC	GOC	GTG	CAC	TTC	GOC	11614
Pro	Leu	Leu	Thr	Ser	Val	Cys	Leu	Leu	Leu	Phe	Ala	Val	His	Phe	Ala	
				3860					3865					3870		
GTG	GOC	GAG	GOC	OGT	ACT	TGG	CAC	AGG	GAA	GGG	OGC	TGG	OGC	GTG	CTG	11662
Val	Ala	Glu	Ala	Arg	Thr	Trp	His	Arg	Glu	Gly	Arg	Trp	Arg	Val	Leu	
			3875					3880					3885			
OGG	CTC	GGA	GOC	TGG	GCG	OGG	TGG	CTG	CTG	GTG	GCG	CTG	ACG	GCG	GOC	11710
Arg	Leu	Gly	Ala	Trp	Ala	Arg	Trp	Leu	Leu	Val	Ala	Leu	Thr	Ala	Ala	
		3890					3895					3900				
ACG	GCA	CTG	GTA	OGC	CTC	GOC	CAG	CTG	GGT	GOC	GCT	GAC	OGC	CAG	TGG	11758
Thr	Ala	Leu	Val	Arg	Leu	Ala	Gln	Leu	Gly	Ala	Ala	Asp	Arg	Gln	Trp	
	3905					3910					3915					
ACC	OGT	TTC	GTG	OGC	GGC	OGC	OGG	OGC	OGC	TTC	ACT	AGC	TTC	GAC	CAG	11806
Thr	Arg	Phe	Val	Arg	Gly	Arg	Pro	Arg	Arg	Phe	Thr	Ser	Phe	Asp	Gln	
3920					3925					3930					3935	
GTG	GCG	CAC	GTG	AGC	TOC	GCA	GOC	OGT	GGC	CTG	GCG	GOC	TOG	CTG	CTC	11854
Val	Ala	His	Val	Ser	Ser	Ala	Ala	Arg	Gly	Leu	Ala	Ala	Ser	Leu	Leu	
				3940					3945					3950		
TTC	CTG	CTT	TTG	GTC	AAG	GCT	GOC	CAG	CAC	GTA	OGC	TTC	GTG	OGC	CAG	11902
Phe	Leu	Leu	Leu	Val	Lys	Ala	Ala	Gln	His	Val	Arg	Phe	Val	Arg	Gln	
			3955					3960					3965			
TGG	TOC	GTC	TTT	GGC	AAG	ACA	TTA	TGC	OGA	GCT	CTG	OCA	GAG	CTC	CTG	11950
Trp	Ser	Val	Phe	Gly	Lys	Thr	Leu	Cys	Arg	Ala	Leu	Pro	Glu	Leu	Leu	
	3970						3975					3980				
GGG	GTC	ACC	TTG	GGC	CTG	GTG	GTG	CTC	GGG	GTA	GOC	TAC	GOC	CAG	CTG	11998
Gly	Val	Thr	Leu	Gly	Leu	Val	Val	Leu	Gly	Val	Ala	Tyr	Ala	Gln	Leu	
	3985				3990					3995						
GOC	ATC	CTG	CTC	GTG	TCT	TOC	TGT	GTG	GAC	TOC	CTC	TGG	AGC	GTG	GOC	12046
Ala	Ile	Leu	Leu	Val	Ser	Ser	Cys	Val	Asp	Ser	Leu	Trp	Ser	Val	Ala	
4000					4005				4010						4015	
CAG	GOC	CTG	TTG	GTG	CTG	TGC	OCT	GGG	ACT	GGG	CTC	TCT	ACC	CTG	TGT	12094
Gln	Ala	Leu	Leu	Val	Leu	Cys	Pro	Gly	Thr	Gly	Leu	Ser	Thr	Leu	Cys	
				4020				4025						4030		
OCT	GOC	GAG	TOC	TGG	CAC	CTG	TCA	OGC	CTG	CTG	TGT	GTG	GGG	CTC	TGG	12142
Pro	Ala	Glu	Ser	Trp	His	Leu	Ser	Pro	Leu	Leu	Cys	Val	Gly	Leu	Trp	
			4035					4040				4045				
GCA	CTG	OGG	CTG	TGG	GGC	GOC	CTA	OGG	CTG	GGG	GCT	GTT	ATT	CTC	OGC	12190
Ala	Leu	Arg	Leu	Trp	Gly	Ala	Leu	Arg	Leu	Gly	Ala	Val	Ile	Leu	Arg	
		4050					4055					4060				
TGG	OGC	TAC	CAC	GOC	TTG	OGT	GGA	GAG	CTG	TAC	OGG	OGG	GOC	TGG	GAG	12238
Trp	Arg	Tyr	His	Ala	Leu	Arg	Gly	Glu	Leu	Tyr	Arg	Pro	Ala	Trp	Glu	
	4065					4070				4075						

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CCC CAG GAC TAC GAG ATG GTG GAG TTG TTC CTG CGC AGG CTG CGC CTC Pro Gln Asp Tyr Glu Met Val Glu Leu Phe Leu Arg Arg Leu Arg Leu 4080 4085 4090 4095	12286
TGG ATG GGC CTC AGC AAG GTC AAG GAG TTC CGC CAC AAA GTC CGC TTT Trp Met Gly Leu Ser Lys Val Lys Glu Phe Arg His Lys Val Arg Phe 4100 4105 4110	12334
GAA GGG ATG GAG CCG CTG CCC TCT CGC TOC TOC AGG GGC TOC AAG GTA Glu Gly Met Glu Pro Leu Pro Ser Arg Ser Ser Arg Gly Ser Lys Val 4115 4120 4125	12382
TOC CCG GAT GTG CCC CCA CCC AGC GCT GGC TOC GAT GGC TOG CAC CCC Ser Pro Asp Val Pro Pro Pro Ser Ala Gly Ser Asp Ala Ser His Pro 4130 4135 4140	12430
TOC AOC TOC TOC AGC CAG CTG GAT GGG CTG AGC GTG AGC CTG GGC CCG Ser Thr Ser Ser Ser Gln Leu Asp Gly Leu Ser Val Ser Leu Gly Arg 4145 4150 4155	12478
CTG GGG ACA AGG TGT GAG OCT GAG CCC TOC CGC CTC CAA GGC GTG TTC Leu Gly Thr Arg Cys Glu Pro Glu Pro Ser Arg Leu Gln Ala Val Phe 4160 4165 4170 4175	12526
GAG GGC CTG CTC AOC CAG TTT GAC CGA CTC AAC CAG GGC ACA GAG GAC Glu Ala Leu Leu Thr Gln Phe Asp Arg Leu Asn Gln Ala Thr Glu Asp 4180 4185 4190	12574
GTC TAC CAG CTG GAG CAG CAG CTG CAC AGC CTG CAA GGC CGC AGG AGC Val Tyr Gln Leu Glu Gln Gln Leu His Ser Leu Gln Gly Arg Arg Ser 4195 4200 4205	12622
AGC CCG GCG CCC GGC GGA TCT TOC CGT GGC CCA TOC CCG GGC CTG CCG Ser Arg Ala Pro Ala Gly Ser Ser Arg Gly Pro Ser Pro Gly Leu Arg 4210 4215 4220	12670
CCA GCA CTG CCC AGC CCG CTT GGC CCG GGC AGT CCG GGT GTG GAC CTG Pro Ala Leu Pro Ser Arg Leu Ala Arg Ala Ser Arg Gly Val Asp Leu 4225 4230 4235	12718
GGC ACT GGC CCC AGC AGG ACA OCT TOG GGC CAA GAA CAA GGT CCA CCC Ala Thr Gly Pro Ser Arg Thr Pro Ser Gly Gln Glu Gln Gly Pro Pro 4240 4245 4250 4255	12766
CAG CAG CAC TTA GTC CTC CTT OCT GGC GGG GGT GGG CCG TGG AGT CCG Gln Gln His Leu Val Leu Leu Pro Gly Gly Gly Gly Pro Trp Ser Arg 4260 4265 4270	12814
AGT GGA CAC CGC TCA GTA TTA CTT TCT GGC GCT GTC AAG GGC GAG GGC Ser Gly His Arg Ser Val Leu Leu Ser Ala Ala Val Lys Ala Glu Gly 4275 4280 4285	12862
CAG GCA GAA TGG CTG CAC GTA GGT TOC CCA GAG AGC AGG CAG GGC CAT Gln Ala Glu Trp Leu His Val Gly Ser Pro Glu Ser Arg Gln Gly His 4290 4295 4300	12910
CTG TCT GTC TGT GGG CTT CAG CAC TTT AAA GAG GCT GTG TGG CCA AOC Leu Ser Val Cys Gly Leu Gln His Phe Lys Glu Ala Val Trp Pro Thr 4305 4310 4315	12958

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AGG AOC CAG GGT OOC CTC OOC AGC TOC CTT GGG AAG GAC ACA GCA GTA 13006
 Arg Thr Gln Gly Pro Leu Pro Ser Ser Leu Gly Lys Asp Thr Ala Val
 4320 4325 4330 4335

TTG GAC GGT TTC TAGOCTCTGA GATGCTAATT TATTTTCCOOG AGTOCTCAGG 13058
 Leu Asp Gly Phe

TACAGOGGGC TGTGCOOOGC OOCACOOOCT GGGCAGATGT OOOOACTGC TAAGGCTGCT 13118

GGCTTCAGGG AGGGTTAGOC TGCACOGGOG OCACOOCTGOC OCTAAGTTAT TAOCTCTOCA 13178

GTTTOCTAOCG TACTOOCTGC ACOGTCTCAC TGTGTGTCTC GTGTCAGTAA TTTATATGGT 13238

GTTAAAATGT GTATATTTTT GTATGTCACT ATTTTCACTA GGGCTGAGGG GOCTGOGOOO 13298

AGAGCTGGOC TDOOCCAACA OCTGCTGOGC TTGGTAGGTG TGGTGGOGTT ATGGCAGOOO 13358

GGCTGCTGCT TGGATGOGAG CTTGGOOCTTG GGOOGGTGCT GGGGGCACAG CTGTCTGOCA 13418

GGCACTCTCA TCACOOOCAGA GGCOCTTGTC TOCTOOCTTG OOCAGGOCA GGTAGCAAGA 13478

GAGCAGOGOC CAGGOCTGCT GGCATCAGGT CTGGGCAAGT AGCAGGACTA GGCATGTGAG 13538

AGGACOOOCAG GGTGGTTAGA GGAAAAGACT OCTOCTGGGG GCTGGCTOOC AGGGTGGAGG 13598

AAGGTGACTG TGTGTGTGTG TGTGTGOGOG OGOAGOGOC GAGTGTGCTG TATGGOOOCAG 13658

GCAGOOCTCAA GGOOCTGGGA GCTGGCTGTG OCTGCTTCTG TGTACCACTT CTGTGGGCAT 13718

GGOOGCTTCT AGAGOOCTOGA CACOOOOOOC AOOOOOGCAC CAAGCAGACA AAGTCAATAA 13778

AAGAGCTGTC TGACTGCAAA AAAAAAAAAA 13807

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 2:

Gly Ala Ala Cys Arg Val Asn Cys Ser Gly Arg Gly Leu Arg Thr Leu
 1 5 10 15

Gly Pro Ala Leu Arg Ile Pro Ala Asp Ala Thr Ala Leu Asp Val Ser
 20 25 30

His Asn Leu Leu Arg Ala Leu Asp Val Gly Leu Leu Ala Asn Leu Ser
 35 40 45

Ala Leu Ala Glu Leu Asp Ile Ser Asn Asn Lys Ile Ser Thr Leu Glu
 50 55 60

Glu Gly Ile Phe Ala Asn Leu Phe Asn Leu Ser Glu Ile Asn Leu Ser
 65 70 75 80

Gly Asn Pro Phe Glu Cys Asp Cys Gly Leu Ala Trp Leu Pro Arg Trp
 85 90 95

Ala Glu Glu Gln Gln Val Arg Val Val Gln Pro Glu Ala Ala Thr Cys
 100 105 110

Ala Gly Pro Gly Ser Leu Ala Gly Gln Pro Leu Leu Gly Ile Pro Leu
 115 120 125

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Leu Asp Ser Gly Cys Gly Glu Glu Tyr Val Ala Cys Leu Pro Asp Asn
 130 135 140
 Ser Ser Gly Thr Val Ala Ala Val Ser Phe Ser Ala Ala His Glu Gly
 145 150 155 160
 Leu Leu Gln Pro Glu Ala Cys Ser Ala Phe Cys Phe Ser Thr Gly Gln
 165 170 175
 Gly Leu Ala Ala Leu Ser Glu Gln Gly Trp Cys Leu Cys Gly Ala Ala
 180 185 190
 Gln Pro Ser Ser Ala Ser Phe Ala Cys Leu Ser Leu Cys Ser Gly Pro
 195 200 205
 Pro Pro Pro Pro Ala Pro Thr Cys Arg Gly Pro Thr Leu Leu Gln His
 210 215 220
 Val Phe Pro Ala Ser Pro Gly Ala Thr Leu Val Gly Pro His Gly Pro
 225 230 235 240
 Leu Ala Ser Gly Gln Leu Ala Ala Phe His Ile Ala Ala Pro Leu Pro
 245 250 255
 Val Thr Ala Thr Arg Trp Asp Phe Gly Asp Gly Ser Ala Glu Val Asp
 260 265 270
 Ala Ala Gly Pro Ala Ala Ser His Arg Tyr Val Leu Pro Gly Arg Tyr
 275 280 285
 His Val Thr Ala Val Leu Ala Leu Gly Ala Gly Ser Ala Leu Leu Gly
 290 295 300
 Thr Asp Val Gln Val Glu Ala Ala Pro Ala Ala Leu Glu Leu Val Cys
 305 310 315 320
 Pro Ser Ser Val Gln Ser Asp Glu Ser Leu Asp Leu Ser Ile Gln Asn
 325 330 335
 Arg Gly Gly Ser Gly Leu Glu Ala Ala Tyr Ser Ile Val Ala Leu Gly
 340 345 350
 Glu Glu Pro Ala Arg Ala Val His Pro Leu Cys Pro Ser Asp Thr Glu
 355 360 365
 Ile Phe Pro Gly Asn Gly His Cys Tyr Arg Leu Val Val Glu Lys Ala
 370 375 380
 Ala Trp Leu Gln Ala Gln Glu Gln Cys Gln Ala Trp Ala Gly Ala Ala
 385 390 395 400
 Leu Ala Met Val Asp Ser Pro Ala Val Gln Arg Phe Leu Val Ser Arg
 405 410 415
 Val Thr Arg Ser Leu Asp Val Trp Ile Gly Phe Ser Thr Val Gln Gly
 420 425 430
 Val Glu Val Gly Pro Ala Pro Gln Gly Glu Ala Phe Ser Leu Glu Ser
 435 440 445
 Cys Gln Asn Trp Leu Pro Gly Glu Pro His Pro Ala Thr Ala Glu His
 450 455 460

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Cys Val Arg Leu Gly Pro Thr Gly Trp Cys Asn Thr Asp Leu Cys Ser
 465 470 475 480
 Ala Pro His Ser Tyr Val Cys Glu Leu Gln Pro Gly Gly Pro Val Gln
 485 490 495
 Asp Ala Glu Asn Leu Leu Val Gly Ala Pro Ser Gly Asp Leu Gln Gly
 500 505 510
 Pro Leu Thr Pro Leu Ala Gln Gln Asp Gly Leu Ser Ala Pro His Glu
 515 520 525
 Pro Val Glu Val Met Val Phe Pro Gly Leu Arg Leu Ser Arg Glu Ala
 530 535 540
 Phe Leu Thr Thr Ala Glu Phe Gly Thr Gln Glu Leu Arg Arg Pro Ala
 545 550 555 560
 Gln Leu Arg Leu Gln Val Tyr Arg Leu Leu Ser Thr Ala Gly Thr Pro
 565 570 575
 Glu Asn Gly Ser Glu Pro Glu Ser Arg Ser Pro Asp Asn Arg Thr Gln
 580 585 590
 Leu Ala Pro Ala Cys Met Pro Gly Gly Arg Trp Cys Pro Gly Ala Asn
 595 600 605
 Ile Cys Leu Pro Leu Asp Ala Ser Cys His Pro Gln Ala Cys Ala Asn
 610 615 620
 Gly Cys Thr Ser Gly Pro Gly Leu Pro Gly Ala Pro Tyr Ala Leu Trp
 625 630 635 640
 Arg Glu Phe Leu Phe Ser Val Ala Ala Gly Pro Pro Ala Gln Tyr Ser
 645 650 655
 Val Thr Leu His Gly Gln Asp Val Leu Met Leu Pro Gly Asp Leu Val
 660 665 670
 Gly Leu Gln His Asp Ala Gly Pro Gly Ala Leu Leu His Cys Ser Pro
 675 680 685
 Ala Pro Gly His Pro Gly Pro Gln Ala Pro Tyr Leu Ser Ala Asn Ala
 690 695 700
 Ser Ser Trp Leu Pro His Leu Pro Ala Gln Leu Glu Gly Thr Trp Ala
 705 710 715 720
 Cys Pro Ala Cys Ala Leu Arg Leu Leu Ala Ala Thr Glu Gln Leu Thr
 725 730 735
 Val Leu Leu Gly Leu Arg Pro Asn Pro Gly Leu Arg Met Pro Gly Arg
 740 745 750
 Tyr Glu Val Arg Ala Glu Val Gly Asn Gly Val Ser Arg His Asn Leu
 755 760 765
 Ser Cys Ser Phe Asp Val Val Ser Pro Val Ala Gly Leu Arg Val Ile
 770 775 780
 Tyr Pro Ala Pro Arg Asp Gly Arg Leu Tyr Val Pro Thr Asn Gly Ser
 785 790 795 800

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Ala Leu Val Leu Gln Val Asp Ser Gly Ala Asn Ala Thr Ala Thr Ala
805 810 815

Arg Trp Pro Gly Gly Ser Val Ser Ala Arg Phe Glu Asn Val Cys Pro
820 825 830

Ala Leu Val Ala Thr Phe Val Pro Gly Cys Pro Trp Glu Thr Asn Asp
835 840 845

Thr Leu Phe Ser Val Val Ala Leu Pro Trp Leu Ser Glu Gly Glu His
850 855 860

Val Val Asp Val Val Val Glu Asn Ser Ala Ser Arg Ala Asn Leu Ser
865 870 875 880

Leu Arg Val Thr Ala Glu Glu Pro Ile Cys Gly Leu Arg Ala Thr Pro
885 890 895

Ser Pro Glu Ala Arg Val Leu Gln Gly Val Leu Val Arg Tyr Ser Pro
900 905 910

Val Val Glu Ala Gly Ser Asp Met Val Phe Arg Trp Thr Ile Asn Asp
915 920 925

Lys Gln Ser Leu Thr Phe Gln Asn Val Val Phe Asn Val Ile Tyr Gln
930 935 940

Ser Ala Ala Val Phe Lys Leu Ser Leu Thr Ala Ser Asn His Val Ser
945 950 955 960

Asn Val Thr Val Asn Tyr Asn Val Thr Val Glu Arg Met Asn Arg Met
965 970 975

Gln Gly Leu Gln Val Ser Thr Val Pro Ala Val Leu Ser Pro Asn Ala
980 985 990

Thr Leu Val Leu Thr Gly Gly Val Leu Val Asp Ser Ala Val Glu Val
995 1000 1005

Ala Phe Leu Trp Asn Phe Gly Asp Gly Glu Gln Ala Leu His Gln Phe
1010 1015 1020

Gln Pro Pro Tyr Asn Glu Ser Phe Pro Val Pro Asp Pro Ser Val Ala
1025 1030 1035 1040

Gln Val Leu Val Glu His Asn Val Met His Thr Tyr Ala Ala Pro Gly
1045 1050 1055

Glu Tyr Leu Leu Thr Val Leu Ala Ser Asn Ala Phe Glu Asn Leu Thr
1060 1065 1070

Gln Gln Val Pro Val Ser Val Arg Ala Ser Leu Pro Ser Val Ala Val
1075 1080 1085

Gly Val Ser Asp Gly Val Leu Val Ala Gly Arg Pro Val Thr Phe Tyr
1090 1095 1100

Pro His Pro Leu Pro Ser Pro Gly Gly Val Leu Tyr Thr Trp Asp Phe
1105 1110 1115 1120

Gly Asp Gly Ser Pro Val Leu Thr Gln Ser Gln Pro Ala Ala Asn His
1125 1130 1135

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Thr Tyr Ala Ser Arg Gly Thr Tyr His Val Arg Leu Glu Val Asn Asn
 1140 1145 1150
 Thr Val Ser Gly Ala Ala Ala Gln Ala Asp Val Arg Val Phe Glu Glu
 1155 1160 1165
 Leu Arg Gly Leu Ser Val Asp Met Ser Leu Ala Val Glu Gln Gly Ala
 1170 1175 1180
 Pro Val Val Val Ser Ala Ala Val Gln Thr Gly Asp Asn Ile Thr Trp
 1185 1190 1195 1200
 Thr Phe Asp Met Gly Asp Gly Thr Val Leu Ser Gly Pro Glu Ala Thr
 1205 1210 1215
 Val Glu His Val Tyr Leu Arg Ala Gln Asn Cys Thr Val Thr Val Gly
 1220 1225 1230
 Ala Ala Ser Pro Ala Gly His Leu Ala Arg Ser Leu His Val Leu Val
 1235 1240 1245
 Phe Val Leu Glu Val Leu Arg Val Glu Pro Ala Ala Cys Ile Pro Thr
 1250 1255 1260
 Gln Pro Asp Ala Arg Leu Thr Ala Tyr Val Thr Gly Asn Pro Ala His
 1265 1270 1275 1280
 Tyr Leu Phe Asp Trp Thr Phe Gly Asp Gly Ser Ser Asn Thr Thr Val
 1285 1290 1295
 Arg Gly Cys Pro Thr Val Thr His Asn Phe Thr Arg Ser Gly Thr Phe
 1300 1305 1310
 Pro Leu Ala Leu Val Leu Ser Ser Arg Val Asn Arg Ala His Tyr Phe
 1315 1320 1325
 Thr Ser Ile Cys Val Glu Pro Glu Val Gly Asn Val Thr Leu Gln Pro
 1330 1335 1340
 Glu Arg Gln Phe Val Gln Leu Gly Asp Glu Ala Trp Leu Val Ala Cys
 1345 1350 1355 1360
 Ala Trp Pro Pro Phe Pro Tyr Arg Tyr Thr Trp Asp Phe Gly Thr Glu
 1365 1370 1375
 Glu Ala Ala Pro Thr Arg Ala Arg Gly Pro Glu Val Thr Phe Ile Tyr
 1380 1385 1390
 Arg Asp Pro Gly Ser Tyr Leu Val Thr Val Thr Ala Ser Asn Asn Ile
 1395 1400 1405
 Ser Ala Ala Asn Asp Ser Ala Leu Val Glu Val Gln Glu Pro Val Leu
 1410 1415 1420
 Val Thr Ser Ile Lys Val Asn Gly Ser Leu Gly Leu Glu Leu Gln Gln
 1425 1430 1435 1440
 Pro Tyr Leu Phe Ser Ala Val Gly Arg Gly Arg Pro Ala Ser Tyr Leu
 1445 1450 1455

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Trp Asp Leu Gly Asp Gly Gly Trp Leu Glu Gly Pro Glu Val Thr His
1460 1465 1470

Ala Tyr Asn Ser Thr Gly Asp Phe Thr Val Arg Val Ala Gly Trp Asn
1475 1480 1485

Glu Val Ser Arg Ser Glu Ala Trp Leu Asn Val Thr Val Lys Arg Arg
1490 1495 1500

Val Arg Gly Leu Val Val Asn Ala Ser Arg Thr Val Val Pro Leu Asn
1505 1510 1515 1520

Gly Ser Val Ser Phe Ser Thr Ser Leu Glu Ala Gly Ser Asp Val Arg
1525 1530 1535

Tyr Ser Trp Val Leu Cys Asp Arg Cys Thr Pro Ile Pro Gly Gly Pro
1540 1545 1550

Thr Ile Ser Tyr Thr Phe Arg Ser Val Gly Thr Phe Asn Ile Ile Val
1555 1560 1565

Thr Ala Glu Asn Glu Val Gly Ser Ala Gln Asp Ser Ile Phe Val Tyr
1570 1575 1580

Val Leu Gln Leu Ile Glu Gly Leu Gln Val Val Gly Gly Gly Arg Tyr
1585 1590 1595 1600

Phe Pro Thr Asn His Thr Val Gln Leu Gln Ala Val Val Arg Asp Gly
1605 1610 1615

Thr Asn Val Ser Tyr Ser Trp Thr Ala Trp Arg Asp Arg Gly Pro Ala
1620 1625 1630

Leu Ala Gly Ser Gly Lys Gly Phe Ser Leu Thr Val Leu Glu Ala Gly
1635 1640 1645

Thr Tyr His Val Gln Leu Arg Ala Thr Asn Met Leu Gly Ser Ala Trp
1650 1655 1660

Ala Asp Cys Thr Met Asp Phe Val Glu Pro Val Gly Trp Leu Met Val
1665 1670 1675 1680

Thr Ala Ser Pro Asn Pro Ala Ala Val Asn Thr Ser Val Thr Leu Ser
1685 1690 1695

Ala Glu Leu Ala Gly Gly Ser Gly Val Val Tyr Thr Trp Ser Leu Glu
1700 1705 1710

Glu Gly Leu Ser Trp Glu Thr Ser Glu Pro Phe Thr Thr His Ser Phe
1715 1720 1725

Pro Thr Pro Gly Leu His Leu Val Thr Met Thr Ala Gly Asn Pro Leu
1730 1735 1740

Gly Ser Ala Asn Ala Thr Val Glu Val Asp Val Gln Val Pro Val Ser
1745 1750 1755 1760

Gly Leu Ser Ile Arg Ala Ser Glu Pro Gly Gly Ser Phe Val Ala Ala
1765 1770 1775

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Gly Ser Ser Val Pro Phe Trp Gly Gln Leu Ala Thr Gly Thr Asn Val
 1780 1785 1790
 Ser Trp Cys Trp Ala Val Pro Gly Gly Ser Ser Lys Arg Gly Pro His
 1795 1800 1805
 Val Thr Met Val Phe Pro Asp Ala Gly Thr Phe Ser Ile Arg Leu Asn
 1810 1815 1820
 Ala Ser Asn Ala Val Ser Trp Val Ser Ala Thr Tyr Asn Leu Thr Ala
 1825 1830 1835 1840
 Glu Glu Pro Ile Val Gly Leu Val Leu Trp Ala Ser Ser Lys Val Val
 1845 1850 1855
 Ala Pro Gly Gln Leu Val His Phe Gln Ile Leu Leu Ala Ala Gly Ser
 1860 1865 1870
 Ala Val Thr Phe Arg Leu Gln Val Gly Gly Ala Asn Pro Glu Val Leu
 1875 1880 1885
 Pro Gly Pro Arg Phe Ser His Ser Phe Pro Arg Val Gly Asp His Val
 1890 1895 1900
 Val Ser Val Arg Gly Lys Asn His Val Ser Trp Ala Gln Ala Gln Val
 1905 1910 1915 1920
 Arg Ile Val Val Leu Glu Ala Val Ser Gly Leu Gln Met Pro Asn Cys
 1925 1930 1935
 Cys Glu Pro Gly Ile Ala Thr Gly Thr Glu Arg Asn Phe Thr Ala Arg
 1940 1945 1950
 Val Gln Arg Gly Ser Arg Val Ala Tyr Ala Trp Tyr Phe Ser Leu Gln
 1955 1960 1965
 Lys Val Gln Gly Asp Ser Leu Val Ile Leu Ser Gly Arg Asp Val Thr
 1970 1975 1980
 Tyr Thr Pro Val Ala Ala Gly Leu Leu Glu Ile Gln Val Arg Ala Phe
 1985 1990 1995 2000
 Asn Ala Leu Gly Ser Glu Asn Arg Thr Leu Val Leu Glu Val Gln Asp
 2005 2010 2015
 Ala Val Gln Tyr Val Ala Leu Gln Ser Gly Pro Cys Phe Thr Asn Arg
 2020 2025 2030
 Ser Ala Gln Phe Glu Ala Ala Thr Ser Pro Ser Pro Arg Arg Val Ala
 2035 2040 2045
 Tyr His Trp Asp Phe Gly Asp Gly Ser Pro Gly Gln Asp Thr Asp Glu
 2050 2055 2060
 Pro Arg Ala Glu His Ser Tyr Leu Arg Pro Gly Asp Tyr Arg Val Gln
 2065 2070 2075 2080
 Val Asn Ala Ser Asn Leu Val Ser Phe Phe Val Ala Gln Ala Thr Val
 2085 2090 2095

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Thr Val Gln Val Leu Ala Cys Arg Glu Pro Glu Val Asp Val Val Leu
 2100 2105 2110
 Pro Leu Gln Val Leu Met Arg Arg Ser Gln Arg Asn Tyr Leu Glu Ala
 2115 2120 2125
 His Val Asp Leu Arg Asp Cys Val Thr Tyr Gln Thr Glu Tyr Arg Trp
 2130 2135 2140
 Glu Val Tyr Arg Thr Ala Ser Cys Gln Arg Pro Gly Arg Pro Ala Arg
 2145 2150 2155 2160
 Val Ala Leu Pro Gly Val Asp Val Ser Arg Pro Arg Leu Val Leu Pro
 2165 2170 2175
 Arg Leu Ala Leu Pro Val Gly His Tyr Cys Phe Val Phe Val Val Ser
 2180 2185 2190
 Phe Gly Asp Thr Pro Leu Thr Gln Ser Ile Gln Ala Asn Val Thr Val
 2195 2200 2205
 Ala Pro Glu Arg Leu Val Pro Ile Ile Glu Gly Gly Ser Tyr Arg Val
 2210 2215 2220
 Trp Ser Asp Thr Arg Asp Leu Val Leu Asp Gly Ser Glu Ser Tyr Asp
 2225 2230 2235 2240
 Pro Asn Leu Glu Asp Gly Asp Gln Thr Pro Leu Ser Phe His Trp Ala
 2245 2250 2255
 Cys Val Ala Ser Thr Gln Arg Glu Ala Gly Gly Cys Ala Leu Asn Phe
 2260 2265 2270
 Gly Pro Arg Gly Ser Ser Thr Val Thr Ile Pro Arg Glu Arg Leu Ala
 2275 2280 2285
 Ala Gly Val Glu Tyr Thr Phe Ser Leu Thr Val Trp Lys Ala Gly Arg
 2290 2295 2300
 Lys Glu Glu Ala Thr Asn Gln Thr Val Leu Ile Arg Ser Gly Arg Val
 2305 2310 2315 2320
 Pro Ile Val Ser Leu Glu Cys Val Ser Cys Lys Ala Gln Ala Val Tyr
 2325 2330 2335
 Glu Val Ser Arg Ser Ser Tyr Val Tyr Leu Glu Gly Arg Cys Leu Asn
 2340 2345 2350
 Cys Ser Ser Gly Ser Lys Arg Gly Arg Trp Ala Ala Arg Thr Phe Ser
 2355 2360 2365
 Asn Lys Thr Leu Val Leu Asp Glu Thr Thr Thr Ser Thr Gly Ser Ala
 2370 2375 2380
 Gly Met Arg Leu Val Leu Arg Arg Gly Val Leu Arg Asp Gly Glu Gly
 2385 2390 2395 2400
 Tyr Thr Phe Thr Leu Thr Val Leu Gly Arg Ser Gly Glu Glu Glu Gly
 2405 2410 2415

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Cys Ala Ser Ile Arg Leu Ser Pro Asn Arg Pro Pro Leu Gly Gly Ser
 2420 2425 2430
 Cys Arg Leu Phe Pro Leu Gly Ala Val His Ala Leu Thr Thr Lys Val
 2435 2440 2445
 His Phe Glu Cys Thr Gly Trp His Asp Ala Glu Asp Ala Gly Ala Pro
 2450 2455 2460
 Leu Val Tyr Ala Leu Leu Leu Arg Arg Cys Arg Gln Gly His Cys Glu
 2465 2470 2475 2480
 Glu Phe Cys Val Tyr Lys Gly Ser Leu Ser Ser Tyr Gly Ala Val Leu
 2485 2490 2495
 Pro Pro Gly Phe Arg Pro His Phe Glu Val Gly Leu Ala Val Val Val
 2500 2505 2510
 Gln Asp Gln Leu Gly Ala Ala Val Val Ala Leu Asn Arg Ser Leu Ala
 2515 2520 2525
 Ile Thr Leu Pro Glu Pro Asn Gly Ser Ala Thr Gly Leu Thr Val Trp
 2530 2535 2540
 Leu His Gly Leu Thr Ala Ser Val Leu Pro Gly Leu Leu Arg Gln Ala
 2545 2550 2555 2560
 Asp Pro Gln His Val Ile Glu Tyr Ser Leu Ala Leu Val Thr Val Leu
 2565 2570 2575
 Asn Glu Tyr Glu Arg Ala Leu Asp Val Ala Ala Glu Pro Lys His Glu
 2580 2585 2590
 Arg Gln His Arg Ala Gln Ile Arg Lys Asn Ile Thr Glu Thr Leu Val
 2595 2600 2605
 Ser Leu Arg Val His Thr Val Asp Asp Ile Gln Gln Ile Ala Ala Ala
 2610 2615 2620
 Leu Ala Gln Cys Met Gly Pro Ser Arg Glu Leu Val Cys Arg Ser Cys
 2625 2630 2635 2640
 Leu Lys Gln Thr Leu His Lys Leu Glu Ala Met Met Leu Ile Leu Gln
 2645 2650 2655
 Ala Glu Thr Thr Ala Gly Thr Val Thr Pro Thr Ala Ile Gly Asp Ser
 2660 2665 2670
 Ile Leu Asn Ile Thr Gly Asp Leu Ile His Leu Ala Ser Ser Asp Val
 2675 2680 2685
 Arg Ala Pro Gln Pro Ser Glu Leu Gly Ala Glu Ser Pro Ser Arg Met
 2690 2695 2700
 Val Ala Ser Gln Ala Tyr Asn Leu Thr Ser Ala Leu Met Arg Ile Leu
 2705 2710 2715 2720
 Met Arg Ser Arg Val Leu Asn Glu Glu Pro Leu Thr Leu Ala Gly Glu
 2725 2730 2735

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Glu Ile Val Ala Gln Gly Lys Arg Ser Asp Pro Arg Ser Leu Leu Cys
 2740 2745 2750
 Tyr Gly Gly Ala Pro Gly Pro Gly Cys His Phe Ser Ile Pro Glu Ala
 2755 2760 2765
 Phe Ser Gly Ala Leu Ala Asn Leu Ser Asp Val Val Gln Leu Ile Phe
 2770 2775 2780
 Leu Val Asp Ser Asn Pro Phe Pro Phe Gly Tyr Ile Ser Asn Tyr Thr
 2785 2790 2795 2800
 Val Ser Thr Lys Val Ala Ser Met Ala Phe Gln Thr Gln Ala Gly Ala
 2805 2810 2815
 Gln Ile Pro Ile Glu Arg Leu Ala Ser Glu Arg Ala Ile Thr Val Lys
 2820 2825 2830
 Val Pro Asn Asn Ser Asp Trp Ala Ala Arg Gly His Arg Ser Ser Ala
 2835 2840 2845
 Asn Ser Ala Asn Ser Val Val Val Gln Pro Gln Ala Ser Val Gly Ala
 2850 2855 2860
 Val Val Thr Leu Asp Ser Ser Asn Pro Ala Ala Gly Leu His Leu Gln
 2865 2870 2875 2880
 Leu Asn Tyr Thr Leu Leu Asp Gly His Tyr Leu Ser Glu Glu Pro Glu
 2885 2890 2895
 Pro Tyr Leu Ala Val Tyr Leu His Ser Glu Pro Arg Pro Asn Glu His
 2900 2905 2910
 Asn Cys Ser Ala Ser Arg Arg Ile Arg Pro Glu Ser Leu Gln Gly Ala
 2915 2920 2925
 Asp His Arg Pro Tyr Thr Phe Phe Ile Ser Pro Gly Ser Arg Asp Pro
 2930 2935 2940
 Ala Gly Ser Tyr His Leu Asn Leu Ser Ser His Phe Arg Trp Ser Ala
 2945 2950 2955 2960
 Leu Gln Val Ser Val Gly Leu Tyr Thr Ser Leu Cys Gln Tyr Phe Ser
 2965 2970 2975
 Glu Glu Asp Met Val Trp Arg Thr Glu Gly Leu Leu Pro Leu Glu Glu
 2980 2985 2990
 Thr Ser Pro Arg Gln Ala Val Cys Leu Thr Arg His Leu Thr Ala Phe
 2995 3000 3005
 Gly Ala Ser Leu Phe Val Pro Pro Ser His Val Arg Phe Val Phe Pro
 3010 3015 3020
 Glu Pro Thr Ala Asp Val Asn Tyr Ile Val Met Leu Thr Cys Ala Val
 3025 3030 3035 3040
 Cys Leu Val Thr Tyr Met Val Met Ala Ala Ile Leu His Lys Leu Asp
 3045 3050 3055

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Gln Leu Asp Ala Ser Arg Gly Arg Ala Ile Pro Phe Cys Gly Gln Arg
 3060 3065 3070
 Gly Arg Phe Lys Tyr Glu Ile Leu Val Lys Thr Gly Trp Gly Arg Gly
 3075 3080 3085
 Ser Gly Thr Thr Ala His Val Gly Ile Met Leu Tyr Gly Val Asp Ser
 3090 3095 3100
 Arg Ser Gly His Arg His Leu Asp Gly Asp Arg Ala Phe His Arg Asn
 3105 3110 3115 3120
 Ser Leu Asp Ile Phe Arg Ile Ala Thr Pro His Ser Leu Gly Ser Val
 3125 3130 3135
 Trp Lys Ile Arg Val Trp His Asp Asn Lys Gly Leu Ser Pro Ala Trp
 3140 3145 3150
 Phe Leu Gln His Val Ile Val Arg Asp Leu Gln Thr Ala Arg Ser Ala
 3155 3160 3165
 Phe Phe Leu Val Asn Asp Trp Leu Ser Val Glu Thr Glu Ala Asn Gly
 3170 3175 3180
 Gly Leu Val Glu Lys Glu Val Leu Ala Ala Ser Asp Ala Ala Leu Leu
 3185 3190 3195 3200
 Arg Phe Arg Arg Leu Leu Val Ala Glu Leu Gln Arg Gly Phe Phe Asp
 3205 3210 3215
 Lys His Ile Trp Leu Ser Ile Trp Asp Arg Pro Pro Arg Ser Arg Phe
 3220 3225 3230
 Thr Arg Ile Gln Arg Ala Thr Cys Cys Val Leu Leu Ile Cys Leu Phe
 3235 3240 3245
 Leu Gly Ala Asn Ala Val Trp Tyr Gly Ala Val Gly Asp Ser Ala Tyr
 3250 3255 3260
 Ser Thr Gly His Val Ser Arg Leu Ser Pro Leu Ser Val Asp Thr Val
 3265 3270 3275 3280
 Ala Val Gly Leu Val Ser Ser Val Val Val Tyr Pro Val Tyr Leu Ala
 3285 3290 3295
 Ile Leu Phe Leu Phe Arg Met Ser Arg Ser Lys Val Ala Gly Ser Pro
 3300 3305 3310
 Ser Pro Thr Pro Ala Gly Gln Gln Val Leu Asp Ile Asp Ser Cys Leu
 3315 3320 3325
 Asp Ser Ser Val Leu Asp Ser Ser Phe Leu Thr Phe Ser Gly Leu His
 3330 3335 3340
 Ala Glu Ala Phe Val Gly Gln Met Lys Ser Asp Leu Phe Leu Asp Asp
 3345 3350 3355 3360
 Ser Lys Ser Leu Val Cys Trp Pro Ser Gly Glu Gly Thr Leu Ser Trp
 3365 3370 3375

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Pro Asp Leu Leu Ser Asp Pro Ser Ile Val Gly Ser Asn Leu Arg Gln
 3380 3385 3390
 Leu Ala Arg Gly Gln Ala Gly His Gly Leu Gly Pro Glu Glu Asp Gly
 3395 3400 3405
 Phe Ser Leu Ala Ser Pro Tyr Ser Pro Ala Lys Ser Phe Ser Ala Ser
 3410 3415 3420
 Asp Glu Asp Leu Ile Gln Gln Val Leu Ala Glu Gly Val Ser Ser Pro
 3425 3430 3435 3440
 Ala Pro Thr Gln Asp Thr His Met Glu Thr Asp Leu Leu Ser Ser Leu
 3445 3450 3455
 Ser Ser Thr Pro Gly Glu Lys Thr Glu Thr Leu Ala Leu Gln Arg Leu
 3460 3465 3470
 Gly Glu Leu Gly Pro Pro Ser Pro Gly Leu Asn Trp Glu Gln Pro Gln
 3475 3480 3485
 Ala Ala Arg Leu Ser Arg Thr Gly Leu Val Glu Gly Leu Arg Lys Arg
 3490 3495 3500
 Leu Leu Pro Ala Trp Cys Ala Ser Leu Ala His Gly Leu Ser Leu Leu
 3505 3510 3515 3520
 Leu Val Ala Val Ala Val Ala Val Ser Gly Trp Val Gly Ala Ser Phe
 3525 3530 3535
 Pro Pro Gly Val Ser Val Ala Trp Leu Leu Ser Ser Ser Ala Ser Phe
 3540 3545 3550
 Leu Ala Ser Phe Leu Gly Trp Glu Pro Leu Lys Val Leu Leu Glu Ala
 3555 3560 3565
 Leu Tyr Phe Ser Leu Val Ala Lys Arg Leu His Pro Asp Glu Asp Asp
 3570 3575 3580
 Thr Leu Val Glu Ser Pro Ala Val Thr Pro Val Ser Ala Arg Val Pro
 3585 3590 3595 3600
 Arg Val Arg Pro Pro His Gly Phe Ala Leu Phe Leu Ala Lys Glu Glu
 3605 3610 3615
 Ala Arg Lys Val Lys Arg Leu His Gly Met Leu Arg Ser Leu Leu Val
 3620 3625 3630
 Tyr Met Leu Phe Leu Leu Val Thr Leu Leu Ala Ser Tyr Gly Asp Ala
 3635 3640 3645
 Ser Cys His Gly His Ala Tyr Arg Leu Gln Ser Ala Ile Lys Gln Glu
 3650 3655 3660
 Leu His Ser Arg Ala Phe Leu Ala Ile Thr Arg Ser Glu Glu Leu Trp
 3665 3670 3675 3680
 Pro Trp Met Ala His Val Leu Leu Pro Tyr Val His Gly Asn Gln Ser
 3685 3690 3695

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Ser Pro Glu Leu Gly Pro Pro Arg Leu Arg Gln Val Arg Leu Gln Glu
3700 3705 3710

Ala Leu Tyr Pro Asp Pro Pro Gly Pro Arg Val His Thr Cys Ser Ala
3715 3720 3725

Ala Gly Gly Phe Ser Thr Ser Asp Tyr Asp Val Gly Trp Glu Ser Pro
3730 3735 3740

His Asn Gly Ser Gly Thr Trp Ala Tyr Ser Ala Pro Asp Leu Leu Gly
3745 3750 3755 3760

Ala Trp Ser Trp Gly Ser Cys Ala Val Tyr Asp Ser Gly Gly Tyr Val
3765 3770 3775

Gln Glu Leu Gly Leu Ser Leu Glu Glu Ser Arg Asp Arg Leu Arg Phe
3780 3785 3790

Leu Gln Leu His Asn Trp Leu Asp Asn Arg Ser Arg Ala Val Phe Leu
3795 3800 3805

Glu Leu Thr Arg Tyr Ser Pro Ala Val Gly Leu His Ala Ala Val Thr
3810 3815 3820

Leu Arg Leu Glu Phe Pro Ala Ala Gly Arg Ala Leu Ala Ala Leu Ser
3825 3830 3835 3840

Val Arg Pro Phe Ala Leu Arg Arg Leu Ser Ala Gly Leu Ser Leu Pro
3845 3850 3855

Leu Leu Thr Ser Val Cys Leu Leu Leu Phe Ala Val His Phe Ala Val
3860 3865 3870

Ala Glu Ala Arg Thr Trp His Arg Glu Gly Arg Trp Arg Val Leu Arg
3875 3880 3885

Leu Gly Ala Trp Ala Arg Trp Leu Leu Val Ala Leu Thr Ala Ala Thr
3890 3895 3900

Ala Leu Val Arg Leu Ala Gln Leu Gly Ala Ala Asp Arg Gln Trp Thr
3905 3910 3915 3920

Arg Phe Val Arg Gly Arg Pro Arg Arg Phe Thr Ser Phe Asp Gln Val
3925 3930 3935

Ala His Val Ser Ser Ala Ala Arg Gly Leu Ala Ala Ser Leu Leu Phe
3940 3945 3950

Leu Leu Leu Val Lys Ala Ala Gln His Val Arg Phe Val Arg Gln Trp
3955 3960 3965

Ser Val Phe Gly Lys Thr Leu Cys Arg Ala Leu Pro Glu Leu Leu Gly
3970 3975 3980

Val Thr Leu Gly Leu Val Val Leu Gly Val Ala Tyr Ala Gln Leu Ala
3985 3990 3995 4000

Ile Leu Leu Val Ser Ser Cys Val Asp Ser Leu Trp Ser Val Ala Gln
4005 4010 4015

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Ala Leu Leu Val Leu Cys Pro Gly Thr Gly Leu Ser Thr Leu Cys Pro
 4020 4025 4030

Ala Glu Ser Trp His Leu Ser Pro Leu Leu Cys Val Gly Leu Trp Ala
 4035 4040 4045

Leu Arg Leu Trp Gly Ala Leu Arg Leu Gly Ala Val Ile Leu Arg Trp
 4050 4055 4060

Arg Tyr His Ala Leu Arg Gly Glu Leu Tyr Arg Pro Ala Trp Glu Pro
 4065 4070 4075 4080

Gln Asp Tyr Glu Met Val Glu Leu Phe Leu Arg Arg Leu Arg Leu Trp
 4085 4090 4095

Met Gly Leu Ser Lys Val Lys Glu Phe Arg His Lys Val Arg Phe Glu
 4100 4105 4110

Gly Met Glu Pro Leu Pro Ser Arg Ser Ser Arg Gly Ser Lys Val Ser
 4115 4120 4125

Pro Asp Val Pro Pro Pro Ser Ala Gly Ser Asp Ala Ser His Pro Ser
 4130 4135 4140

Thr Ser Ser Ser Gln Leu Asp Gly Leu Ser Val Ser Leu Gly Arg Leu
 4145 4150 4155 4160

Gly Thr Arg Cys Glu Pro Glu Pro Ser Arg Leu Gln Ala Val Phe Glu
 4165 4170 4175

Ala Leu Leu Thr Gln Phe Asp Arg Leu Asn Gln Ala Thr Glu Asp Val
 4180 4185 4190

Tyr Gln Leu Glu Gln Gln Leu His Ser Leu Gln Gly Arg Arg Ser Ser
 4195 4200 4205

Arg Ala Pro Ala Gly Ser Ser Arg Gly Pro Ser Pro Gly Leu Arg Pro
 4210 4215 4220

Ala Leu Pro Ser Arg Leu Ala Arg Ala Ser Arg Gly Val Asp Leu Ala
 4225 4230 4235 4240

Thr Gly Pro Ser Arg Thr Pro Ser Gly Gln Glu Gln Gly Pro Pro Gln
 4245 4250 4255

Gln His Leu Val Leu Leu Pro Gly Gly Gly Gly Pro Trp Ser Arg Ser
 4260 4265 4270

Gly His Arg Ser Val Leu Leu Ser Ala Ala Val Lys Ala Glu Gly Gln
 4275 4280 4285

Ala Glu Trp Leu His Val Gly Ser Pro Glu Ser Arg Gln Gly His Leu
 4290 4295 4300

Ser Val Cys Gly Leu Gln His Phe Lys Glu Ala Val Trp Pro Thr Arg
 4305 4310 4315 4320

Thr Gln Gly Pro Leu Pro Ser Ser Leu Gly Lys Asp Thr Ala Val Leu
 4325 4330 4335

Asp Gly Phe

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(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 3: (Compare Figure 7)

CTC AAC GAG GAG CCG CTG ACG CTG GCG GGC GAG GAG ATC GTG GGC CAG Leu Asn Glu Glu Pro Leu Thr Leu Ala Gly Glu Glu Ile Val Ala Gln 4340 4345 4350 4355	48
GGC AAG CGC TCG GAC CCG CGG AGC CTG CTG TGC TAT GGC GGC GGC CCA Gly Lys Arg Ser Asp Pro Arg Ser Leu Leu Cys Tyr Gly Gly Ala Pro 4360 4365 4370	96
GGG OCT GGC TGC CAC TTC TCC ATC CCC GAG GCT TTC AGC GGG GGC CTG Gly Pro Gly Cys His Phe Ser Ile Pro Glu Ala Phe Ser Gly Ala Leu 4375 4380 4385	144
GCC AAC CTC AGT GAC GTG GTG CAG CTC ATC TTT CTG GTG GAC TOC AAT Ala Asn Leu Ser Asp Val Val Gln Leu Ile Phe Leu Val Asp Ser Asn 4390 4395 4400	192
CCC TTT CCC TTT GGC TAT ATC AGC AAC TAC ACC GTC TOC ACC AAG GTG Pro Phe Pro Phe Gly Tyr Ile Ser Asn Tyr Thr Val Ser Thr Lys Val 4405 4410 4415	240
GCC TCG ATG GCA TTC CAG ACA CAG GCC GGC GGC CAG ATC CCC ATC GAG Ala Ser Met Ala Phe Gln Thr Gln Ala Gly Ala Gln Ile Pro Ile Glu 4420 4425 4430 4435	288
CGG CTG GGC TCA GAG CGC GCC ATC ACC GTG AAG GTG CCC AAC AAC TCG Arg Leu Ala Ser Glu Arg Ala Ile Thr Val Lys Val Pro Asn Asn Ser 4440 4445 4450	336
GAC TGG GCT GGC CCG GGC CAC CGC AGC TOC GCC AAC TOC GCC AAC TOC Asp Trp Ala Ala Arg Gly His Arg Ser Ser Ala Asn Ser Ala Asn Ser 4455 4460 4465	384
GTT GTG GTC CAG CCC CAG GCC TOC GTC GGT GCT GTG GTC ACC CTG GAC Val Val Val Gln Pro Gln Ala Ser Val Gly Ala Val Val Thr Leu Asp 4470 4475 4480	432
AGC AGC AAC OCT GCG GGC GGG CTG CAT CTG CAG CTC AAC TAT ACG CTG Ser Ser Asn Pro Ala Ala Gly Leu His Leu Gln Leu Asn Tyr Thr Leu 4485 4490 4495	480
CTG GAC GGC CAC TAC CTG TCT GAG GAA OCT GAG CCC TAC CTG GCA GTC Leu Asp Gly His Tyr Leu Ser Glu Glu Pro Glu Pro Tyr Leu Ala Val 4500 4505 4510 4515	528
TAC CTA CAC TCG GAG CCC CGG CCC AAT GAG CAC AAC TGC TOG GCT AGC Tyr Leu His Ser Glu Pro Arg Pro Asn Glu His Asn Cys Ser Ala Ser 4520 4525 4530	576
AGG AGG ATC CGC CCA GAG TCA CTC CAG GGT GCT GAC CAC CGG CCC TAC Arg Arg Ile Arg Pro Glu Ser Leu Gln Gly Ala Asp His Arg Pro Tyr 4535 4540 4545	624
AAC TTC TTC ATT TOC CCG GGG AGC AGA GAC CCA GCG GGG AGT TAC CAT Thr Phe Phe Ile Ser Pro Gly Ser Arg Asp Pro Ala Gly Ser Tyr His 4550 4555 4560	672
CTG AAC CTC TOC AGC CAC TTC CGC TGG TOG GCG CTG CAG GTG TOC GTG Leu Asn Leu Ser Ser His Phe Arg Trp Ser Ala Leu Gln Val Ser Val 4565 4570 4575	720

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GGC CTG TAC ACG TOC CTG TGC CAG TAC TTC AGC GAG GAG GAC ATG GTG Gly Leu Tyr Thr Ser Leu Cys Gln Tyr Phe Ser Glu Glu Asp Met Val 4580 4585 4590 4595	768
TGG OGG ACA GAG GGG CTG CTG OOC CTG GAG GAG AOC TCG OOC OGC CAG Trp Arg Thr Glu Gly Leu Leu Pro Leu Glu Glu Thr Ser Pro Arg Gln 4600 4605 4610	816
GCC GTC TGC CTC ACC OGC CAC CTC ACC GOC TTC GGC GOC AGC CTC TTC Ala Val Cys Leu Thr Arg His Leu Thr Ala Phe Gly Ala Ser Leu Phe 4615 4620 4625	864
GTG OOC CCA AGC CAT GTC OGC TTT GTG TTT OCT GAG OCG ACA GCG GAT Val Pro Pro Ser His Val Arg Phe Val Phe Pro Glu Pro Thr Ala Asp 4630 4635 4640	912
GTA AAC TAC ATC GTC ATG CTG ACA TGT GCT GTG TGC CTG GTG AOC TAC Val Asn Tyr Ile Val Met Leu Thr Cys Ala Val Cys Leu Val Thr Tyr 4645 4650 4655	960
ATG GTC ATG GOC GOC ATC CTG CAC AAG CTG GAC CAG TTG GAT GOC AGC Met Val Met Ala Ala Ile Leu His Lys Leu Asp Gln Leu Asp Ala Ser 4660 4665 4670 4675	1008
CGG GGC OGC GOC ATC OCT TTC TGT GGG CAG OGG GGC OGC TTC AAG TAC Arg Gly Arg Ala Ile Pro Phe Cys Gly Gln Arg Gly Arg Phe Lys Tyr 4680 4685 4690	1056
GAG ATC CTC GTC AAG ACA GGC TGG GGC OGG GGC TCA GGT AOC AOC GOC Glu Ile Leu Val Lys Thr Gly Trp Gly Arg Gly Ser Gly Thr Thr Ala 4695 4700 4705	1104
CAC GTG GGC ATC ATG CTG TAT GGG GTG GAC AGC OGG AGC GGC CAC OGG His Val Gly Ile Met Leu Tyr Gly Val Asp Ser Arg Ser Gly His Arg 4710 4715 4720	1152
CAC CTG GAC GGC GAC AGA GOC TTC CAC OGC AAC AGC CTG GAC ATC TTC His Leu Asp Gly Asp Arg Ala Phe His Arg Asn Ser Leu Asp Ile Phe 4725 4730 4735	1200
OGG ATC GOC AOC OCG CAC AGC CTG GGT AGC GTG TGG AAG ATC OGA GTG Arg Ile Ala Thr Pro His Ser Leu Gly Ser Val Trp Lys Ile Arg Val 4740 4745 4750 4755	1248
TGG CAC GAC AAC AAA GGG CTC AGC OCT GOC TGG TTC CTG CAG CAC GTC Trp His Asp Asn Lys Gly Leu Ser Pro Ala Trp Phe Leu Gln His Val 4760 4765 4770	1296
ATC GTC AGG GAC CTG CAG ACG GCA OGC AGC GOC TTC TTC CTG GTC AAT Ile Val Arg Asp Leu Gln Thr Ala Arg Ser Ala Phe Phe Leu Val Asn 4775 4780 4785	1344
GAC TGG CTT TOG GTG GAG ACG GAG GOC AAC GGG GGC CTG GTG GAG AAG Asp Trp Leu Ser Val Glu Thr Glu Ala Asn Gly Gly Leu Val Glu Lys 4790 4795 4800	1392
GAG GTG CTG GOC GOG AGC GAC GCA GOC CTT TTG OGC TTC OGG OGC CTG Glu Val Leu Ala Ala Ser Asp Ala Ala Leu Leu Arg Phe Arg Arg Leu 4805 4810 4815	1440
CTG GTG GCT GAG CTG CAG CGT GGC TTC TTT GAC AAG CAC ATC TGG CTC Leu Val Ala Glu Leu Gln Arg Gly Phe Phe Asp Lys His Ile Trp Leu 4820 4825 4830 4835	1488

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TOC ATA TGG GAC OGG OOG OCT OGT AGC OGT TTC ACT OGC ATC CAG AGG Ser Ile Trp Asp Arg Pro Pro Arg Ser Arg Phe Thr Arg Ile Gln Arg 4840 4845 4850	1536
GOC AOC TGC TGC GTT CTC CTC ATC TGC CTC TTC CTG GGC GOC AAC GOC Ala Thr Cys Cys Val Leu Leu Ile Cys Leu Phe Leu Gly Ala Asn Ala 4855 4860 4865	1584
GTG TGG TAC GGG GCT GTT GGC GAC TCT GOC TAC AGC ACG GGG CAT GTG Val Trp Tyr Gly Ala Val Gly Asp Ser Ala Tyr Ser Thr Gly His Val 4870 4875 4880	1632
TOC AGG CTG AGC OOG CTG AGC GTC GAC ACA GTC GCT GTT GGC CTG GTG Ser Arg Leu Ser Pro Leu Ser Val Asp Thr Val Ala Val Gly Leu Val 4885 4890 4895	1680
TOC AGC GTG GTT GTC TAT CCC GTC TAC CTG GOC ATC CTT TTT CTC TTC Ser Ser Val Val Val Tyr Pro Val Tyr Leu Ala Ile Leu Phe Leu Phe 4900 4905 4910 4915	1728
OGG ATG TOC OGG AGC AAG GTG GCT GGG AGC OOG AGC CCC ACA OCT GOC Arg Met Ser Arg Ser Lys Val Ala Gly Ser Pro Ser Pro Thr Pro Ala 4920 4925 4930	1776
GGG CAG CAG GTG CTG GAC ATC GAC AGC TGC CTG GAC TOG TOC GTG CTG Gly Gln Gln Val Leu Asp Ile Asp Ser Cys Leu Asp Ser Ser Val Leu 4935 4940 4945	1824
GAC AGC TOC TTC CTC AOG TTC TCA GGC CTC CAC GCT GAG GOC TTT GTT Asp Ser Ser Phe Leu Thr Phe Ser Gly Leu His Ala Glu Ala Phe Val 4950 4955 4960	1872
GGA CAG ATG AAG AGT GAC TTG TTT CTG GAT GAT TCT AAG AGT CTG GTG Gly Gln Met Lys Ser Asp Leu Phe Leu Asp Asp Ser Lys Ser Leu Val 4965 4970 4975	1920
TGC TGG CCC TOC GGC GAG GGA AOG CTC AGT TGG OOG GAC CTG CTC AGT Cys Trp Pro Ser Gly Glu Gly Thr Leu Ser Trp Pro Asp Leu Leu Ser 4980 4985 4990 4995	1968
GAC OOG TOC ATT GTG GGT AGC AAT CTG OGG CAG CTG GCA OGG GGC CAG Asp Pro Ser Ile Val Gly Ser Asn Leu Arg Gln Leu Ala Arg Gly Gln 5000 5005 5010	2016
GOG GGC CAT GGG CTG GGC OCA GAG GAG GAC GGC TTC TOC CTG GOC AGC Ala Gly His Gly Leu Gly Pro Glu Glu Asp Gly Phe Ser Leu Ala Ser 5015 5020 5025	2064
CCC TAC TOG OCT GOC AAA TOC TTC TCA GCA TCA GAT GAA GAC CTG ATC Pro Tyr Ser Pro Ala Lys Ser Phe Ser Ala Ser Asp Glu Asp Leu Ile 5030 5035 5040	2112
CAG CAG GTC CTT GOC GAG GGG GTC AGC AGC OCA GOC OCT ACC CAA GAC Gln Gln Val Leu Ala Glu Gly Val Ser Ser Pro Ala Pro Thr Gln Asp 5045 5050 5055	2160
2AOC CAC ATG GAA AOG GAC CTG CTC AGC AGC CTG TOC AGC ACT OCT GGG Thr His Met Glu Thr Asp Leu Leu Ser Ser Leu Ser Ser Thr Pro Gly 5060 5065 5070 5075	2208

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GAG AAG ACA GAG ACG CTG GCG CTG CAG AGG CTG GGG GAG CTG GGG OCA Glu Lys Thr Glu Thr Leu Ala Leu Gln Arg Leu Gly Glu Leu Gly Pro 5080 5085 5090	2256
8CCC AGC OCA GGC CTG AAC TGG GAA CAG CCC CAG GCA GCG AGG CTG TOC Pro Ser Pro Gly Leu Asn Trp Glu Gln Pro Gln Ala Ala Arg Leu Ser 5095 5100 5105	2304
AGG ACA GGA CTG GTG GAG GGT CTG OGG AAG CGC CTG CTG CCG GGC TGG Arg Thr Gly Leu Val Glu Gly Leu Arg Lys Arg Leu Leu Pro Ala Trp 5110 5115 5120	2352
TGT GGC TOC CTG GGC CAC GGG CTC AGC CTG CTC CTG GTG GCT GTG GCT Cys Ala Ser Leu Ala His Gly Leu Ser Leu Leu Val Ala Val Ala 5125 5130 5135	2400
GTG GCT GTC TCA GGG TGG GTG GGT GCG AGC TTC CCC CCG GGC GTG AGT Val Ala Val Ser Gly Trp Val Gly Ala Ser Phe Pro Pro Gly Val Ser 5140 5145 5150 5155	2448
GTT GCG TGG CTC CTG TOC AGC AGC GGC AGC TTC CTG GGC TCA TTC CTC Val Ala Trp Leu Leu Ser Ser Ser Ala Ser Phe Leu Ala Ser Phe Leu 5160 5165 5170	2496
GGC TGG GAG OCA CTG AAG GTC TTG CTG GAA GGC CTG TAC TTC TCA CTG Gly Trp Glu Pro Leu Lys Val Leu Leu Glu Ala Leu Tyr Phe Ser Leu 5175 5180 5185	2544
GTG GGC AAG CCG CTG CAC CCG GAT GAA GAT GAC ACC CTG GTA GAG AGC Val Ala Lys Arg Leu His Pro Asp Glu Asp Asp Thr Leu Val Glu Ser 5190 5195 5200	2592
CCG GCT GTG ACG CCT GTG AGC GCA CGT GTG CCC CCG GTA CCG OCA CCC Pro Ala Val Thr Pro Val Ser Ala Arg Val Pro Arg Val Arg Pro Pro 5205 5210 5215	2640
CAC GGC TTT GCA CTC TTC CTG GGC AAG GAA GAA GGC CCG AAG GTC AAG His Gly Phe Ala Leu Phe Leu Ala Lys Glu Glu Ala Arg Lys Val Lys 5220 5225 5230 5235	2688
AGG CTA CAT GGC ATG CTG OGG AGC CTC CTG GTG TAC ATG CTT TTT CTG Arg Leu His Gly Met Leu Arg Ser Leu Leu Val Tyr Met Leu Phe Leu 5240 5245 5250	2736
CTG GTG ACC CTG CTG GGC AGC TAT GGG GAT GGC TCA TGC CAT GGG CAC Leu Val Thr Leu Leu Ala Ser Tyr Gly Asp Ala Ser Cys His Gly His 5255 5260 5265	2784
GCC TAC CGT CTG CAA AGC GGC ATC AAG CAG GAG CTG CAC AGC CCG GCC Ala Tyr Arg Leu Gln Ser Ala Ile Lys Gln Glu Leu His Ser Arg Ala 5270 5275 5280	2832
TTC CTG GGC ATC ACG CCG TCT GAG GAG CTC TGG OCA TGG ATG GGC CAC Phe Leu Ala Ile Thr Arg Ser Glu Glu Leu Trp Pro Trp Met Ala His 5285 5290 5295	2880
GTG CTG CTG CCC TAC GTC CAC GGG AAC CAG TOC AGC OCA GAG CTG GGG Val Leu Leu Pro Tyr Val His Gly Asn Gln Ser Ser Pro Glu Leu Gly 5300 5305 5310 5315	2928
CCC OCA CCG CTG CCG CAG GTG CCG CTG CAG GAA GCA CTC TAC OCA GAC	2976

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OCC	CCA	CGG	CTG	OGG	CAG	GTG	OGG	CTG	CAG	GAA	GCA	CTC	TAC	CCA	GAC	2976
Pro	Pro	Arg	Leu	Arg	Gln	Val	Arg	Leu	Gln	Glu	Ala	Leu	Tyr	Pro	Asp	
				5320					5325					5330		
OCT	CCC	GGC	CCC	AGG	GTC	CAC	ACG	TGC	TGG	GCC	GCA	GGA	GGC	TTC	AGC	3024
Pro	Pro	Gly	Pro	Arg	Val	His	Thr	Cys	Ser	Ala	Ala	Gly	Gly	Phe	Ser	
			5335					5340					5345			
AOC	AGC	GAT	TAC	GAC	GTT	GGC	TGG	GAG	AGT	OCT	CAC	AAT	GGC	TGG	GGG	3072
Thr	Ser	Asp	Tyr	Asp	Val	Gly	Trp	Glu	Ser	Pro	His	Asn	Gly	Ser	Gly	
		5350					5355					5360				
ACG	TGG	GCC	TAT	TCA	GCG	COG	GAT	CTG	CTG	GGG	GCA	TGG	TOC	TGG	GGC	3120
Thr	Trp	Ala	Tyr	Ser	Ala	Pro	Asp	Leu	Leu	Gly	Ala	Trp	Ser	Trp	Gly	
	5365					5370					5375					
TOC	TGT	GCC	GTG	TAT	GAC	AGC	GGG	GGC	TAC	GTG	CAG	GAG	CTG	GGC	CTG	3168
Ser	Cys	Ala	Val	Tyr	Asp	Ser	Gly	Gly	Tyr	Val	Gln	Glu	Leu	Gly	Leu	
5380					5385				5390					5395		
AGC	CTG	GAG	GAG	AGC	CGC	GAC	CGG	CTG	CGC	TTC	CTG	CAG	CTG	CAC	AAC	3216
Ser	Leu	Glu	Glu	Ser	Arg	Asp	Arg	Leu	Arg	Phe	Leu	Gln	Leu	His	Asn	
				5400				5405						5410		
TGG	CTG	GAC	AAC	AGG	AGC	CGC	GCT	GTG	TTC	CTG	GAG	CTC	ACG	CGC	TAC	3264
Trp	Leu	Asp	Asn	Arg	Ser	Arg	Ala	Val	Phe	Leu	Glu	Leu	Thr	Arg	Tyr	
			5415					5420					5425			
AGC	COG	GCC	GTG	GGG	CTG	CAC	GCC	GCC	GTC	ACG	CTG	CGC	CTC	GAG	TTC	3312
Ser	Pro	Ala	Val	Gly	Leu	His	Ala	Ala	Val	Thr	Leu	Arg	Leu	Glu	Phe	
		5430					5435					5440				
COG	GCG	GCC	GGC	CGC	GCC	CTG	GCC	GCC	CTC	AGC	GTC	CGC	CCC	TTT	GCG	3360
Pro	Ala	Ala	Gly	Arg	Ala	Leu	Ala	Ala	Leu	Ser	Val	Arg	Pro	Phe	Ala	
	5445					5450					5455					
CTG	CGC	CGC	CTC	AGC	GCG	GGC	CTC	TGG	CTG	OCT	CTG	CTC	AOC	TGG	GTG	3408
Leu	Arg	Arg	Leu	Ser	Ala	Gly	Leu	Ser	Leu	Pro	Leu	Leu	Thr	Ser	Val	
5460					5465				5470						5475	
TGC	CTG	CTG	CTG	TTC	GCC	GTG	CAC	TTC	GCC	GTG	GCC	GAG	GCC	CGT	ACT	3456
Cys	Leu	Leu	Leu	Phe	Ala	Val	His	Phe	Ala	Val	Ala	Glu	Ala	Arg	Thr	
				5480				5485						5490		
TGG	CAC	AGG	GAA	GGG	CGC	TGG	CGC	GTG	CTG	OGG	CTC	GGA	GCC	TGG	GCG	3504
Trp	His	Arg	Arg	Gly	Arg	Trp	Arg	Val	Leu	Arg	Leu	Gly	Ala	Trp	Ala	
			5495					5500					5505			
CGG	TGG	CTG	CTG	GTG	GCG	CTG	ACG	GCG	GCC	ACG	GCA	CTG	GTA	CGC	CTC	3552
Arg	Trp	Leu	Leu	Val	Ala	Leu	Thr	Ala	Ala	Thr	Ala	Leu	Val	Arg	Leu	
		5510					5515					5520				
GCC	CAG	CTG	GGT	GCC	GCT	GAC	CGC	CAG	TGG	AOC	CGT	TTC	GTG	CGC	GCG	3600
Ala	Gln	Leu	Gly	Ala	Ala	Asp	Arg	Gln	Trp	Thr	Arg	Phe	Val	Arg	Gly	
	5525					5530					5535					
CGC	COG	CGC	CGC	TTC	ACT	AGC	TTC	GAC	CAG	GTG	GCG	CAC	GTG	AGC	TOC	3648
Arg	Pro	Arg	Arg	Phe	Thr	Ser	Phe	Asp	Gln	Val	Ala	His	Val	Ser	Ser	
5540					5545				5550						5555	

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GCA GOC CGT GGC CTG GOG GOC TOG CTG CTC TTC CTG CTT TTG GTC AAG Ala Ala Arg Gly Leu Ala Ala Ser Leu Leu Phe Leu Leu Leu Val Lys 5560 5565 5570	3696
2GCT GOC CAG CAC GTA GGC TTC GTG GGC CAG TGG TOC GTC TTT GGC AAG Ala Ala Gln His Val Arg Phe Val Arg Gln Trp Ser Val Phe Gly Lys 5575 5580 5585	3744
ACA TTA TGC CGA GCT CTG OCA GAG CTC CTG GGG GTC ACC TTG GGC CTG Thr Leu Cys Arg Ala Leu Pro Glu Leu Leu Gly Val Thr Leu Gly Leu 5590 5595 5600	3792
GTG GTG CTC GGG GTA GOC TAC GOC CAG CTG GOC ATC CTG CTC GTG TCT Val Val Leu Gly Val Ala Tyr Ala Gln Leu Ala Ile Leu Leu Val Ser 5605 5610 5615	3840
TOC TGT GTG GAC TOC CTC TGG AGC GTG GOC CAG GOC CTG TTG GTG CTG Ser Cys Val Asp Ser Leu Trp Ser Val Ala Gln Ala Leu Leu Val Leu 5620 5625 5630 5635	3888
TGC OCT GGG ACT GGG CTC TCT ACC CTG TGT OCT GOC GAG TOC TGG CAC Cys Pro Gly Thr Gly Leu Ser Thr Leu Cys Pro Ala Glu Ser Trp His 5640 5645 5650	3936
CTG TCA OOC CTG CTG TGT GTG GGG CTC TGG GCA CTG OCG CTG TGG GGC Leu Ser Pro Leu Leu Cys Val Gly Leu Trp Ala Leu Arg Leu Trp Gly 5655 5660 5665	3984
GOC CTA OGC CTG GGG GCT GGT ATT CTC OGC TGG OGC TAC CAC GOC TTG Ala Leu Arg Leu Gly Ala Val Ile Leu Arg Trp Arg Tyr His Ala Leu 5670 5675 5680	4032
OGT GGA GAG CTG TAC OGC OGC GOC TGG GAG OOC CAG GAC TAC GAG ATG Arg Gly Glu Leu Tyr Arg Pro Ala Trp Glu Pro Gln Asp Tyr Glu Met 5685 5690 5695	4080
GTG GAG TTG TTC CTG OGC AGG CTG OGC CTC TGG ATG GGC CTC AGC AAG Val Glu Leu Phe Leu Arg Arg Leu Arg Leu Trp Met Gly Leu Ser Lys 5700 5705 5710 5715	4128
GTC AAG GAG TTC OGC CAC AAA GTC OGC TTT GAA GGG ATG GAG OGC CTG Val Lys Glu Phe Arg His Lys Val Arg Phe Glu Gly Met Glu Pro Leu 5720 5725 5730	4176
OOC TCT OGC TOC TOC AGG GGC TOC AAG GTA TOC OGC GAT GTG OOC OCA Pro Ser Arg Ser Ser Arg Gly Ser Lys Val Ser Pro Asp Val Pro Pro 5735 5740 5745	4224
OOC AGC GCT GGC TOC GAT GOC TOG CAC OOC TOC AOC TOC TOC AGC CAG Pro Ser Ala Gly Ser Asp Ala Ser His Pro Ser Thr Ser Ser Ser Gln 5750 5755 5760	4272
CTG GAT GGG CTG AGC GTG AGC CTG GGC OGC CTG GGG ACA AGG TGT GAG Leu Asp Gly Leu Ser Val Ser Leu Gly Arg Leu Gly Thr Arg Cys Glu 5765 5770 5775	4320
OCT GAG OOC TOC OGC CTC CAA GOC GTG TTC GAG GOC CTG CTC AOC CAG Pro Glu Pro Ser Arg Leu Gln Ala Val Phe Glu Ala Leu Leu Thr Gln 5780 5785 5790 5795	4368

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TTT GAC CGA CTC AAC CAG GGC ACA GAG GAC GTC TAC CAG CTG GAG CAG Phe Asp Arg Leu Asn Gln Ala Thr Glu Asp Val Tyr Gln Leu Glu Gln 5800 5805 5810	4416
CAG CTG CAC AGC CTG CAA GGC CGC AGG AGC AGC CGG GCG OOC GGC GGA Gln Leu His Ser Leu Gln Gly Arg Arg Ser Ser Arg Ala Pro Ala Gly 5815 5820 5825	4464
TCT TOC CGT GGC CCA TOC CCG GGC CTG CGG CCA GCA CTG OOC AGC CGC Ser Ser Arg Gly Pro Ser Pro Gly Leu Arg Pro Ala Leu Pro Ser Arg 5830 5835 5840	4512
CTT GOC CGG GOC AGT CGG GGT GTG GAC CTG GOC ACT GGC OOC AGC AGG Leu Ala Arg Ala Ser Arg Gly Val Asp Leu Ala Thr Gly Pro Ser Arg 5845 5850 5855	4560
ACA OCT TOG GGC CAA GAA CAA GGT CCA CCG CAG CAG CAC TTA GTC CTC Thr Pro Ser Gly Gln Glu Gln Gly Pro Pro Gln Gln His Leu Val Leu 5860 5865 5870 5875	4608
CTT OCT GGC GGG GGT GGG CCG TGG AGT CGG AGT GGA CAC CGC TCA GTA Leu Pro Gly Gly Gly Gly Pro Trp Ser Arg Ser Gly His Arg Ser Val 5880 5885 5890	4656
TTA CTT TCT GOC GCT GTC AAG GOC GAG GGC CAG GCA GAA TGG CTG CAC Leu Leu Ser Ala Ala Val Lys Ala Glu Gly Gln Ala Glu Trp Leu His 5895 5900 5905	4704
GTA GGT TOC CCA GAG AGC AGG CAG GGG CAT CTG TCT GTC TGT GGC CTT Val Gly Ser Pro Glu Ser Arg Gln Gly His Leu Ser Val Cys Gly Leu 5910 5915 5920	4752
CAG CAC TTT AAA GAG GCT GTG TGG CCA AOC AGG AOC CAG GGT OOC CTC Gln His Phe Lys Glu Ala Val Trp Pro Thr Arg Thr Gln Gly Pro Leu 5925 5930 5935	4800
COO AGC TOC CTT GGG AAG GAC ACA GCA GTA TTG GAC GGT TTC Pro Ser Ser Leu Gly Lys Asp Thr Ala Val Leu Asp Gly Phe 5940 5945 5950	4842
TAGCCTCTGA GATGCTAATT TATTTCCCGG AGTCTCAGG TACAGGGGGC TGTGCCCGGC	4902
CCACCCCCCT GGGCAGATGT CCCCCACTGC TAAGGCTGCT GGCTTCAGGG AGGGTTAGOC	4962
2TGCAACGGCGG CCACCCCTGOC CCTAAGTTAT TACCTCTOCA GTTCTACCG TACTCCCTGC	5022
ACCGTCTCAC TGTGTGTCTC GTGTCAGTAA TTTATATGGT GTTAAAATGT GTATATTTTT	5082
GTATGTCACT ATTTTCACTA GGGCTGAGGG GCGTGCGGCC AGAGCTGGOC TCCCCAACA	5142
CCTGCTGCGC TTGGTAGGTG TGGTGGGGTT ATGGCAGGCC GGCTGCTGCT TGGATGCGAG	5202
CTTGGCCTTG GCGCGGTGCT GGGGGCACAG CTGTCTGCA GGCACCTCTCA TCACCCAGAG	5262
GGCCTTGTCA TCTTCCCTTG CCCCAGGCCA GGTAGCAAGA GAGCAGGGOC CAGGCTGCT	5322
GGCATCAGGT CTGGGCAAGT AGCAGGACTA GGCATGTCAG AGGACCCAG GGTGGTTAGA	5382
GGAAAAGACT CCTCTGCGG GCTGGCTCC AGGGTGGAGG AAGGTGACTG TGTGTGTGTG	5442
TGTGTGGGG CGGACCGGC GAGTGTGCTG TATGGGCCAG GCAGCCTCAA GCGCCCTCGA	5502

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GCTGGCTGTG OCTGCTTCTG TGTACCACIT CTGTGGGCAT GGOOGCTTCT AGAGCCTCGA 5562
 CACCCCCCA ACCCCCCGCAC CAAGCAGACA AAGTCAATAA AAGAGCTGTC TGA CTGCAAA 5622
 AAAAAAAAAA 5631

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 4: (Compare Figure 7)

Leu Asn Glu Glu Pro Leu Thr Leu Ala Gly Glu Glu Ile Val Ala Gln
 1 5 10 15
 Gly Lys Arg Ser Asp Pro Arg Ser Leu Leu Cys Tyr Gly Gly Ala Pro
 20 25 30
 Gly Pro Gly Cys His Phe Ser Ile Pro Glu Ala Phe Ser Gly Ala Leu
 35 40 45
 Ala Asn Leu Ser Asp Val Val Gln Leu Ile Phe Leu Val Asp Ser Asn
 50 55 60
 Pro Phe Pro Phe Gly Tyr Ile Ser Asn Tyr Thr Val Ser Thr Lys Val
 65 70 75 80
 Ala Ser Met Ala Phe Gln Thr Gln Ala Gly Ala Gln Ile Pro Ile Glu
 85 90 95
 Arg Leu Ala Ser Glu Arg Ala Ile Thr Val Lys Val Pro Asn Asn Ser
 100 105 110
 Asp Trp Ala Ala Arg Gly His Arg Ser Ser Ala Asn Ser Ala Asn Ser
 115 120 125
 Val Val Val Gln Pro Gln Ala Ser Val Gly Ala Val Val Thr Leu Asp
 130 135 140
 Ser Ser Asn Pro Ala Ala Gly Leu His Leu Gln Leu Asn Tyr Thr Leu
 145 150 155 160
 Leu Asp Gly His Tyr Leu Ser Glu Glu Pro Glu Pro Tyr Leu Ala Val
 165 170 175
 Tyr Leu His Ser Glu Pro Arg Pro Asn Glu His Asn Cys Ser Ala Ser
 180 185 190
 Arg Arg Ile Arg Pro Glu Ser Leu Gln Gly Ala Asp His Arg Pro Tyr
 195 200 205
 Thr Phe Phe Ile Ser Pro Gly Ser Arg Asp Pro Ala Gly Ser Tyr His
 210 215 220
 Leu Asn Leu Ser Ser His Phe Arg Trp Ser Ala Leu Gln Val Ser Val
 225 230 235 240
 Gly Leu Tyr Thr Ser Leu Cys Gln Tyr Phe Ser Glu Glu Asp Met Val
 245 250 255

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Trp Arg Thr Glu Gly Leu Leu Pro Leu Glu Glu Thr Ser Pro Arg Gln
 260 265 270
 Ala Val Cys Leu Thr Arg His Leu Thr Ala Phe Gly Ala Ser Leu Phe
 275 280 285
 Val Pro Pro Ser His Val Arg Phe Val Phe Pro Glu Pro Thr Ala Asp
 290 295 300
 Val Asn Tyr Ile Val Met Leu Thr Cys Ala Val Cys Leu Val Thr Tyr
 305 310 315 320
 Met Val Met Ala Ala Ile Leu His Lys Leu Asp Gln Leu Asp Ala Ser
 325 330 335
 Arg Gly Arg Ala Ile Pro Phe Cys Gly Gln Arg Gly Arg Phe Lys Tyr
 340 345 350
 Glu Ile Leu Val Lys Thr Gly Trp Gly Arg Gly Ser Gly Thr Thr Ala
 355 360 365
 His Val Gly Ile Met Leu Tyr Gly Val Asp Ser Arg Ser Gly His Arg
 370 375 380
 His Leu Asp Gly Asp Arg Ala Phe His Arg Asn Ser Leu Asp Ile Phe
 385 390 395 400
 Arg Ile Ala Thr Pro His Ser Leu Gly Ser Val Trp Lys Ile Arg Val
 405 410 415
 Trp His Asp Asn Lys Gly Leu Ser Pro Ala Trp Phe Leu Gln His Val
 420 425 430
 Ile Val Arg Asp Leu Gln Thr Ala Arg Ser Ala Phe Phe Leu Val Asn
 435 440 445
 Asp Trp Leu Ser Val Glu Thr Glu Ala Asn Gly Gly Leu Val Glu Lys
 450 455 460
 Glu Val Leu Ala Ala Ser Asp Ala Ala Leu Leu Arg Phe Arg Arg Leu
 465 470 475 480
 Leu Val Ala Glu Leu Gln Arg Gly Phe Phe Asp Lys His Ile Trp Leu
 485 490 495
 Ser Ile Trp Asp Arg Pro Pro Arg Ser Arg Phe Thr Arg Ile Gln Arg
 500 505 510
 Ala Thr Cys Cys Val Leu Leu Ile Cys Leu Phe Leu Gly Ala Asn Ala
 515 520 525
 Val Trp Tyr Gly Ala Val Gly Asp Ser Ala Tyr Ser Thr Gly His Val
 530 535 540
 Ser Arg Leu Ser Pro Leu Ser Val Asp Thr Val Ala Val Gly Leu Val
 545 550 555 560
 Ser Ser Val Val Val Tyr Pro Val Tyr Leu Ala Ile Leu Phe Leu Phe
 565 570 575

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Arg Met Ser Arg Ser Lys Val Ala Gly Ser Pro Ser Pro Thr Pro Ala
 580 585 590
 Gly Gln Gln Val Leu Asp Ile Asp Ser Cys Leu Asp Ser Ser Val Leu
 595 600 605
 Asp Ser Ser Phe Leu Thr Phe Ser Gly Leu His Ala Glu Ala Phe Val
 610 615 620
 Gly Gln Met Lys Ser Asp Leu Phe Leu Asp Asp Ser Lys Ser Leu Val
 625 630 635 640
 Cys Trp Pro Ser Gly Glu Gly Thr Leu Ser Trp Pro Asp Leu Leu Ser
 645 650 655
 Asp Pro Ser Ile Val Gly Ser Asn Leu Arg Gln Leu Ala Arg Gly Gln
 660 665 670
 Ala Gly His Gly Leu Gly Pro Glu Glu Asp Gly Phe Ser Leu Ala Ser
 675 680 685
 Pro Tyr Ser Pro Ala Lys Ser Phe Ser Ala Ser Asp Glu Asp Leu Ile
 690 695 700
 Gln Gln Val Leu Ala Glu Gly Val Ser Ser Pro Ala Pro Thr Gln Asp
 705 710 715 720
 Thr His Met Glu Thr Asp Leu Leu Ser Ser Leu Ser Ser Thr Pro Gly
 725 730 735
 Glu Lys Thr Glu Thr Leu Ala Leu Gln Arg Leu Gly Glu Leu Gly Pro
 740 745 750
 Pro Ser Pro Gly Leu Asn Trp Glu Gln Pro Gln Ala Ala Arg Leu Ser
 755 760 765
 Arg Thr Gly Leu Val Glu Gly Leu Arg Lys Arg Leu Leu Pro Ala Trp
 770 775 780
 Cys Ala Ser Leu Ala His Gly Leu Ser Leu Leu Leu Val Ala Val Ala
 785 790 795 800
 Val Ala Val Ser Gly Trp Val Gly Ala Ser Phe Pro Pro Gly Val Ser
 805 810 815
 Val Ala Trp Leu Leu Ser Ser Ser Ala Ser Phe Leu Ala Ser Phe Leu
 820 825 830
 Gly Trp Glu Pro Leu Lys Val Leu Leu Glu Ala Leu Tyr Phe Ser Leu
 835 840 845
 Val Ala Lys Arg Leu His Pro Asp Glu Asp Asp Thr Leu Val Glu Ser
 850 855 860
 Pro Ala Val Thr Pro Val Ser Ala Arg Val Pro Arg Val Arg Pro Pro
 865 870 875 880
 His Gly Phe Ala Leu Phe Leu Ala Lys Glu Glu Ala Arg Lys Val Lys
 885 890 895

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Arg Leu His Gly Met Leu Arg Ser Leu Leu Val Tyr Met Leu Phe Leu
 900 905 910
 Leu Val Thr Leu Leu Ala Ser Tyr Gly Asp Ala Ser Cys His Gly His
 915 920 925
 Ala Tyr Arg Leu Gln Ser Ala Ile Lys Gln Glu Leu His Ser Arg Ala
 930 935 940
 Phe Leu Ala Ile Thr Arg Ser Glu Glu Leu Trp Pro Trp Met Ala His
 945 950 955 960
 Val Leu Leu Pro Tyr Val His Gly Asn Gln Ser Ser Pro Glu Leu Gly
 965 970 975
 Pro Pro Arg Leu Arg Gln Val Arg Leu Gln Glu Ala Leu Tyr Pro Asp
 980 985 990
 Pro Pro Gly Pro Arg Val His Thr Cys Ser Ala Ala Gly Gly Phe Ser
 995 1000 1005
 Thr Ser Asp Tyr Asp Val Gly Trp Glu Ser Pro His Asn Gly Ser Gly
 1010 1015 1020
 Thr Trp Ala Tyr Ser Ala Pro Asp Leu Leu Gly Ala Trp Ser Trp Gly
 1025 1030 1035 1040
 Ser Cys Ala Val Tyr Asp Ser Gly Gly Tyr Val Gln Glu Leu Gly Leu
 1045 1050 1055
 2
 Ser Leu Glu Glu Ser Arg Asp Arg Leu Arg Phe Leu Gln Leu His Asn
 1060 1065 1070
 Trp Leu Asp Asn Arg Ser Arg Ala Val Phe Leu Glu Leu Thr Arg Tyr
 1075 1080 1085
 Ser Pro Ala Val Gly Leu His Ala Ala Val Thr Leu Arg Leu Glu Phe
 1090 1095 1100
 Pro Ala Ala Gly Arg Ala Leu Ala Ala Leu Ser Val Arg Pro Phe Ala
 1105 1110 1115 1120
 Leu Arg Arg Leu Ser Ala Gly Leu Ser Leu Pro Leu Leu Thr Ser Val
 1125 1130 1135
 Cys Leu Leu Leu Phe Ala Val His Phe Ala Val Ala Glu Ala Arg Thr
 1140 1145 1150
 Trp His Arg Glu Gly Arg Trp Arg Val Leu Arg Leu Gly Ala Trp Ala
 1155 1160 1165
 Arg Trp Leu Leu Val Ala Leu Thr Ala Ala Thr Ala Leu Val Arg Leu
 1170 1175 1180
 8
 Ala Gln Leu Gly Ala Ala Asp Arg Gln Trp Thr Arg Phe Val Arg Gly
 1185 1190 1195 1200
 Arg Pro Arg Arg Phe Thr Ser Phe Asp Gln Val Ala His Val Ser Ser
 2 1205 1210 1215

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Ala Ala Arg Gly Leu Ala Ala Ser Leu Leu Phe Leu Leu Leu Val Lys
1220 1225 1230

Ala Ala Gln His Val Arg Phe Val Arg Gln Trp Ser Val Phe Gly Lys
1235 1240 1245

Thr Leu Cys Arg Ala Leu Pro Glu Leu Leu Gly Val Thr Leu Gly Leu
1250 1255 1260

Val Val Leu Gly Val Ala Tyr Ala Gln Leu Ala Ile Leu Leu Val Ser
1265 1270 1275 1280

Ser Cys Val Asp Ser Leu Trp Ser Val Ala Gln Ala Leu Leu Val Leu
1285 1290 1295

Cys Pro Gly Thr Gly Leu Ser Thr Leu Cys Pro Ala Glu Ser Trp His
1300 1305 1310

Leu Ser Pro Leu Leu Cys Val Gly Leu Trp Ala Leu Arg Leu Trp Gly
1315 1320 1325

Ala Leu Arg Leu Gly Ala Val Ile Leu Arg Trp Arg Tyr His Ala Leu
1330 1335 1340

Arg Gly Glu Leu Tyr Arg Pro Ala Trp Glu Pro Gln Asp Tyr Glu Met
1345 1350 1355 1360

Val Glu Leu Phe Leu Arg Arg Leu Arg Leu Trp Met Gly Leu Ser Lys
1365 1370 1375

Val Lys Glu Phe Arg His Lys Val Arg Phe Glu Gly Met Glu Pro Leu
1380 1385 1390

Pro Ser Arg Ser Ser Arg Gly Ser Lys Val Ser Pro Asp Val Pro Pro
1395 1400 1405

Pro Ser Ala Gly Ser Asp Ala Ser His Pro Ser Thr Ser Ser Ser Gln
1410 1415 1420

Leu Asp Gly Leu Ser Val Ser Leu Gly Arg Leu Gly Thr Arg Cys Glu
1425 1430 1435 1440

Pro Glu Pro Ser Arg Leu Gln Ala Val Phe Glu Ala Leu Leu Thr Gln
1445 1450 1455

Phe Asp Arg Leu Asn Gln Ala Thr Glu Asp Val Tyr Gln Leu Glu Gln
1460 1465 1470

Gln Leu His Ser Leu Gln Gly Arg Arg Ser Ser Arg Ala Pro Ala Gly
1475 1480 1485

Ser Ser Arg Gly Pro Ser Pro Gly Leu Arg Pro Ala Leu Pro Ser Arg
1490 1495 1500

Leu Ala Arg Ala Ser Arg Gly Val Asp Leu Ala Thr Gly Pro Ser Arg
1505 1510 1515 1520

Thr Pro Ser Gly Gln Glu Gln Gly Pro Pro Gln Gln His Leu Val Leu
1525 1530 1535

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Leu Pro Gly Gly Gly Gly Pro Trp Ser Arg Ser Gly His Arg Ser Val
 1540 1545 1550

Leu Leu Ser Ala Ala Val Lys Ala Glu Gly Gln Ala Glu Trp Leu His
 1555 1560 1565

Val Gly Ser Pro Glu Ser Arg Gln Gly His Leu Ser Val Cys Gly Leu
 1570 1575 1580

Gln His Phe Lys Glu Ala Val Trp Pro Thr Arg Thr Gln Gly Pro Leu
 1585 1590 1595 1600

Pro Ser Ser Leu Gly Lys Asp Thr Ala Val Leu Asp Gly Phe
 1605 1610

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 5: (Compare Figure 8)

AGCTTGGCAC CATCAAGGGC CAGTTCAACT TTGTCAAGT GATCGTCAOC CCGCTGGACT	60
ACGAGTGCAA OCTGGTGTGC CTGCAGTGCA GGAAAGACAT GGAGGGCCTT GTGGACAACA	120
GCGTGGCCAA GATCGTGTCT GACCGCAACC TGCCCTTGTG GGGCCGOCAG ATGGCCCTGC	180
ACGCAAATAT GGCTCACAG GTGCATCATA GCGCTCCAA CCCCACGAT ATCTACCCCT	240
CCAAGTGGAT TGCCCGGCTC CGCACATCA AGGGCTCCG CCAGCGGATC TGCGAGGAAG	300
CGGCTACTC CAACCCAGC CTAOCTCTGG TGCAOCTOC GTCCATAGC AAAGCCCTG	360
CACAGACTOC AGCCGAGCC ACAOCTGGCT ATGAGGTGGG CCAGCGGAAG CGCTCATCT	420
OCTGGTGA GACTTCAOC GAGTTGTGT GAGGCGGGG CCGCTCCOC TGCACTGGC	480
TTGGAAGTA TTGCTGTCA GTGAAATAA TAAAGTCTG AACCAGTGC ACAGACATAG	540
AGGCACAGAT TGC	553

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 6: (Compare Figure 9)

CTGGTGTGTG TGAGACGTGC GGGGCTGGGA AGTGTGGCA GAGCCGCGAG TACCGTCTC	60
ACTOCTTTTG TTCTTTGAC GTAAGCTGGC GAGTGGCACT GCGTGAATC CGCTCAGTGC	120
CCGCGCTGAT GTGCGGACC CGCTGCATTC TTGCTGTTAG GTGGTGGGG TGTGCGCTGT	180
CGCTGGTGGG CACCGAGAGT CTTGGGAGC TTTGGGGAGG TTGTGCCAAG CCTGAGCCTC	240
GACGTCCCC TTCCCGGCTT TCTGTGGCT CTTCTGAGGC CAGGGCATCT CTATGAGGGC	300
CTOCTGCTGG AGCGTCTCT GTGGATCTOC TCTGOCATOC TGGCCATGA GTGGGTGATG	360
CGCTGGCCAC CATCTGGTGA CAGTGGCGG GCAOOGCTGC CAAATGTGGG TCCCGCATCT	420
GCAAGCCCT CCGTGGGTCC OCTAGGGTAT GGGGTGGTTC TGCCACTGCC CTGCTCCOC	480
CACCTGGGG TGCTCTCC CCGCTCTGTG GGGGAGA	517

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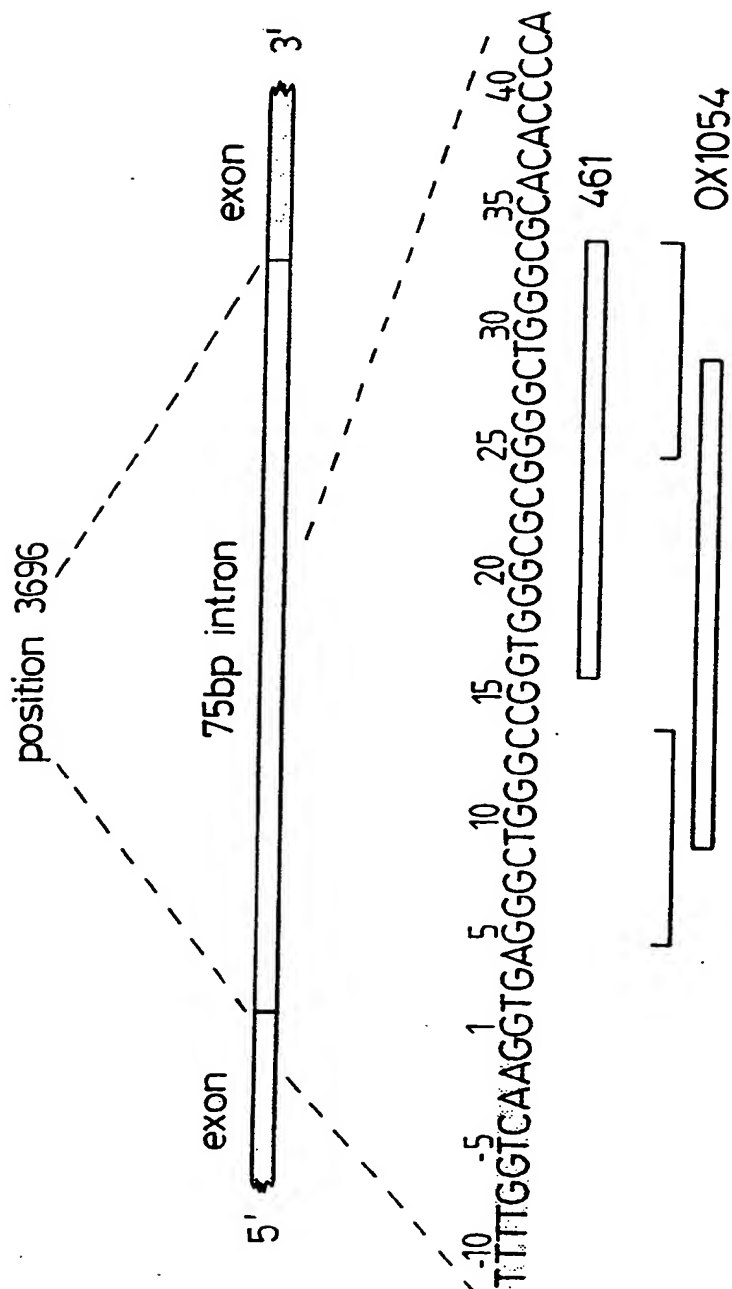
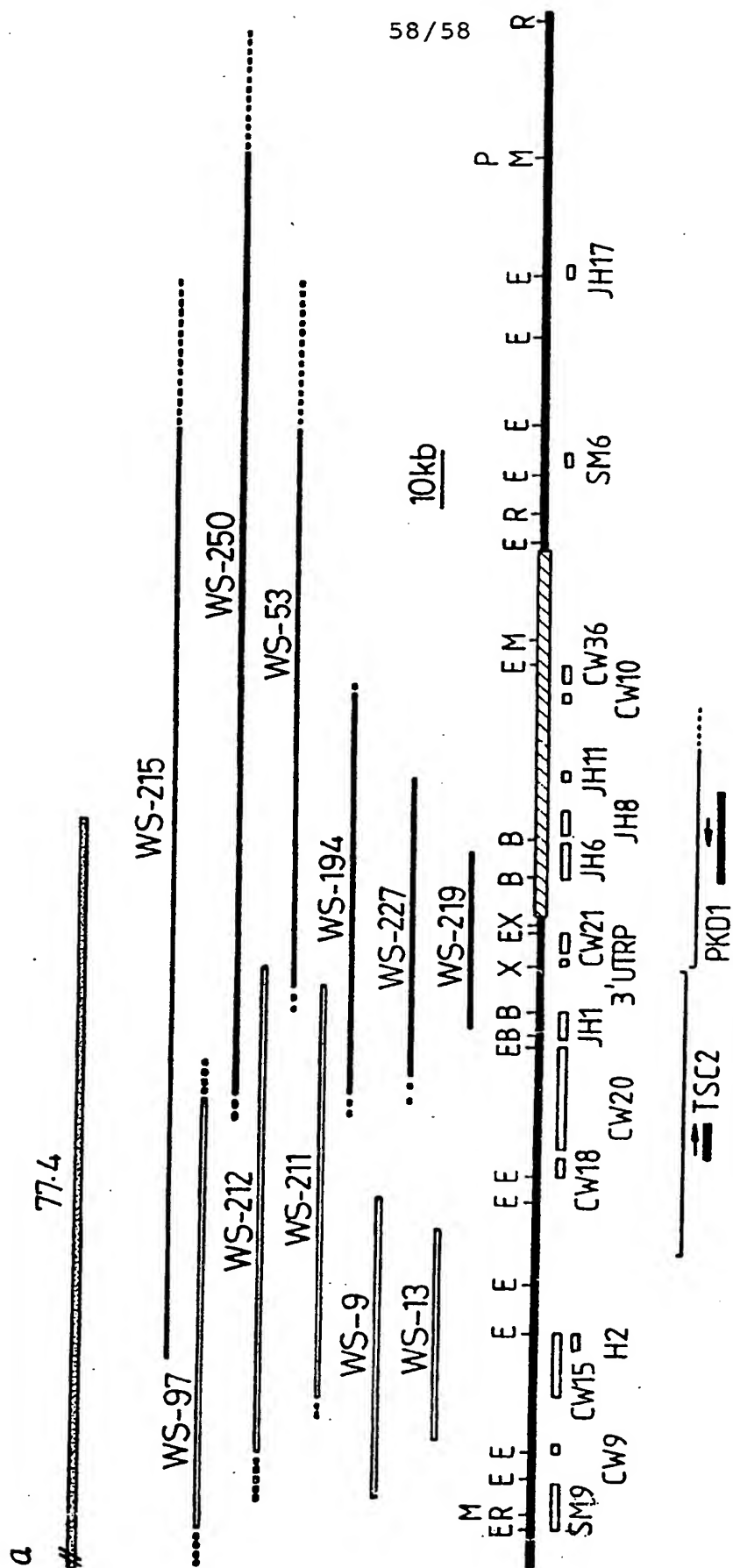


Fig. 11



INTERNATIONAL SEARCH REPORT

Internat Application No
PCT/GB 94/02822

A. CLASSIFICATION OF SUBJECT MATTER IPC 6 C12N15/12 C07K14/47 C12N5/10 A61K48/00 G01N33/68 C12Q1/68 C07K16/18		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 6 C12N A61K C12Q C07K		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	J. AM. SOC. NEPHROL., vol. 4, no. 3, November 1993 page 814	1-3, 6-23
Y	G. GERMINO ET AL 'A novel approach to the identification of the PKD1 gene' see abstract 91p	24-30
Y	--- KIDNEY INTERNATIONAL, vol. 43, no. supp 39, 19 May 1993 pages s20-s25, G. GERMINO ET AL 'Positional cloning approach to the dominant polycystic kidney disease gene, PKD1' see the whole document --- -/--	1-30
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input type="checkbox"/> Patent family members are listed in annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
Date of the actual completion of the international search 8 May 1995		Date of mailing of the international search report 1 9. 05. 95
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040; Tx. 31 651 epo nl, Fax: (+ 31-70) 340-3016		Authorized officer Van der Schaal, C

INTERNATIONAL SEARCH REPORT

Internat 1 Application No

PCT/GB 94/02822

C(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GENOMICS, vol. 13, 1992 pages 144-151, G. GERMINO ET AL 'The gene for autosomal dominant polycystic kidney disease.....' cited in the application see the whole document especially page 150, left column, last paragraph	1-30
Y	--- A. GRIFFITHS ET AL 'An introduction to genetic analysis' 1993, W. FREEMAN AND COMPANY, NEW YORK see page 427 see page 453, left column, last paragraph - right column, paragraph 1 see page 453, right column, last paragraph - page 461	1-30
A	--- CURRENT OPINION IN GENETICS AND DEVELOPMENT, vol. 3, June 1993 pages 425-431, J. MULLEY ET AL 'Integrating maps of chromosome 16'	
X	--- EMBL DATABASE, Accession no. T05931, sequence reference HS9312, Sep. 2 1993; M. ADAMS et al 'Expressed sequence tags identify diversity of transcripts from human brain & NATURE GENETICS, vol. 4, 1993 pages 256-267,	1-3,6,8, 9
X	--- EMBL DATABASE, Accession no. T04943 sequence reference HS9431, August 30, 1993 M. ADAMS et al, 'Expressed sequence tags identify diversity of transcripts from human brain & NATURE GENETICS, vol. 4, 1993 pages 256-267,	1-3,6,8, 9
P,X	--- CELL, vol. 77, 17 June 1994 pages 881-894, C. WARD ET AL 'The polycystic kidney disease 1 gene encodes a 14kb transcript and lies within a duplicated region on chromosome 16' see the whole document -----	1-30

INTERNATIONAL SEARCH REPORT

international application No.

PCT/GB94/02822

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
Although claims 24 partially and 25 are directed to methods of treatment of the human body the search has been carried out and based on the alleged effect of the compound.
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.